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WHITE PINE BLISTER RUST CONTROL

Annual Report
Calendar Year 1962

U.S. DEPARTMENT OF AGRICULTURE
FOREST SERVICE
REGION ONE

MISSOULA, MONTANA

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UNITED STATES DEPARTMENT OF AGRICULTURE

FOREST SERVICE

REGION 1

Missoula, Montana
March 1, 1963

WHITE PINE BLISTER RUST CONTROL ANNUAL REPORT

Calendar Year 1962

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The following agencies are conducting or are actively cooperating in white pine blister rust control:

U.S. Forest Service
National Park Service
State of Idaho
Clearwater Timber Protective Association
Potlatch Timber Protective Association
Priest Lake Timber Protective Association
Bureau of Land Management
University of Idaho

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I. HIGHLIGHTS OF 1962 REGION 1 BLISTER RUST CONTROL PROGRAM

THE OVERALL BLISTER RUST CONTROL PROGRAM

Accomplishments

In 1962 some 27,130 acres were treated with the antibiotic Acti-dione BR by the basal stem method, requiring 12,020 man-days or 0.44 man-days per acre. Phytoactin L-318 was applied by helicopter as a foliar spray to 66,170 acres of heavily infected, immature western white pine stands. Some 1,386 hours of helicopter time were used. Blister rust control crews eradicated the ribes on 17,110 acres requiring 9,485 man-days or 0.55 man-days per acre. Total area treated by all methods is 110,410 acres.

Control Methods

The following selective methods of white pine blister rust control are being practiced or developed:

1. Control through ribes eradication in stands under 10 years of age.

2. Application of antifungal antibiotics to kill present rust infections.

3. Application of antibiotics to immunize healthy pines against blister rust infection.

4. Development and mass production of blister rust resistant western white pine planting stock through forest genetics.

Antibiotic Treatment Results

The use of antibiotics is making a very substantial contribution in the control of white pine blister rust. To date, 214,000 acres of the 1,213,000 acres of immature stands being considered for antibiotic control have been treated. During the last 4 years antibiotics have been extensively applied to western white pine stands in 6 National Forests, 3 Timber Protective Associations and 1 National Park. While it is still too early to draw final conclusions with respect to formulations, application techniques and evaluation of results, it is evident that the many factors which influence antibiotic results are highly complex. Some of the more important influencing factors are (1) chemical composition of water and/or fuel oil used in spray formulations, (2) amount of moisture present on trees at time of application, (3) influence of high or low temperatures at time of treatment, (4) individual tree or stand physiological differences, (5) age of stand, and (6) seasonal growth stage at time of treatment.

Little is known, but much is supposed, about the fungicidal action of antibiotics when applied on blister rust infection. The eradicative effect upon the organism may be either or both a direct attack and/or a preventative action. An early, positive determination of treated infections, as to whether active or completely inactive, is often very difficult. Reasonably reliable determinations can be made after three full-growth periods following the

application of Acti-dione. It appears that 5 years may be required for evaluation of stands aerially treated with Phytoactin.

Advancements are being made each year in antibiotic control methods and results appear to correspondingly improve. A general analysis of antibiotic results for this pioneering period indicates that, of the potentially damaging blister rust infections, some biological action occurred on almost all infections, resulting in arresting 70 to 80 percent of all infections. It is estimated that 50 to 60 percent of all infections treated are dead or will die. Many of the infections showing positive signs of life after treatment have been substantially retarded in growth and vigor.

There is no margin for error in the successful application of antibiotics for the control of white pine blister rust. For fully effective results, the required final spray solution must be correctly formulated and properly applied under exacting conditions.

Antibiotic Persistence

The exact period of blister rust infection immunity that will result from a single application of an antibiotic is not known. New infection has not been detected on any pines treated with antibiotics in this Region. While it is now evident that antibiotics remain biologically active in treated trees for a period of time, the antibiotic persistence level required to prevent new rust infection is not known.

Immunization of Western White Pine Nursery Stock

Starting in 1963, all western white pine nursery stock will be given several treatments of Phytoactin prior to outplanting in an attempt to immunize this stock against blister rust. At this time no specific guarantee can be made regarding immediate or long-range benefits from these antibiotic treatments. Current test results appear promising. The cost of treatment is low, and there is no apparent damage to nursery stock.

Antibiotic Treatment Needed for Mature Stands

Some 3 billion board feet of mature and overmature western white pine in the Clearwater River drainage, on lands of all ownerships, are heavily infected with the rust and are in need of antibiotic treatment. Tree mortality is occurring at a more rapid rate than originally predicted. Damage appraisals indicate that about 75 percent of the mature trees have lethal bole cankers or have lethal branch cankers capable of reaching the bole. The time of death for the average lethally infected tree is placed at 1970 to 1975. Some of these infected trees will live longer than 1975, but some are already dead while others will die in the near future.

There is more mature western white pine in the Clearwater River drainage, on lands of all ownerships that should be logged now, than the white pine economy can currently absorb. This is the last remaining large block of mature western white pine in the Inland Empire and every possible control effort should be made that will permit the harvesting of these stands in a profitable manner, at a rather constant rate during the next 30 to 40 years, in order that present immature western white pine stands will have had time to reach commercial maturity.

It is hoped that the examinations to be made during June 1963 in the aerial antibiotic test plots established in these stands in 1961 will indicate satisfactory infection kill so that aerial spray operations on a project basis can be initiated in the fall of 1963.

Antibiotic Results on Limber and Whitebark Pines

Effective antibiotic formulations and/or application techniques still have not been fully developed for killing blister rust infection on limber and whitebark pines. Antibiotics applied by the basal stem method kill most of the infections within the treated area, but there is little evidence of any effective translocation of the antibiotics.

Antibiotic Side Effects

No harmful side effects of any importance have been associated with the treating of 215,590 acres with antibiotics. However, the bark of young pines under certain conditions has been spot burned by Acti-dione when applied by the basal stem method during the rapid growth period in hot weather. Pines thus injured nearly always fully recover within 2 years.

Antibiotic Mixing-Service Units Developed

Seven 2,000-gallon military surplus semitrailer fuel tankers will have been converted to field units by the spring of 1963 for mixing antibiotic formulations, and direct servicing of aircraft employed in aerial spray operations. This will be sufficient mixing-service units to aerially treat 112,000 acres annually.

Spread of the Rust

Extensive scouting for new blister rust infections outside of the known limits of the rust was not conducted in 1962.

Limited rust infection surveys conducted in unprotected western white pine reproduction stands indicate that during the past 10 years new rust infection occurred at the rate of 1 to 3 percent a year. During the period 1952-1961 no heavy pine infection wave-years appeared to have occurred. During the fall of 1962, weather conditions seemed to be highly favorable for the occurrence of pine infection.

Most all limber and whitebark pine stands throughout the Region are now generally infected with white pine blister rust. These noncommercial species of high esthetic value have never been protected from the rust in Region 1 except in National Parks. By the year 2000 nearly all of the present unprotected stand will have been killed. One of the saddening facts relating to the passing of these pines is that they often occupy forest sites not suited to any other tree species.

New Economic Study

A 3-year economic study of western white pine production and management in the Inland Empire was initiated in July 1962.

First Cooperative Agreement

The first cooperative agreement for antibiotic treatment of pine stands of an individual landowner was made in 1962. The stands treated were selected by the landowner. The treatment was applied by the U.S. Forest Service and costs were shared on a 50-50 basis.

New Antibiotic Formulations

The nonphytotoxic antibiotic Phytoactin L-440 indicates good promise when applied by the basal stem method. Additional field tests will be made in 1963 and observations of results of 1961 test plots will be continued. Promising new antibiotics, not commercially produced, are being tested. Antibiotics in combination will be tested in 1963. Methods and value of antibiotic retreatment are being studied.

Personnel Change

In June 1962 Henry J. Viche, Head, Blister Rust Control Section, transferred to the Division of Fire Control and was replaced by David A. Graham.

CLEARWATER NATIONAL FOREST AND CLEARWATER TIMBER PROTECTIVE ASSOCIATION

All planned blister rust control objectives were met or exceeded in the 1962 field season. During 1962, more than 20,000 acres were treated with some type of measure to control blister rust. This acreage is the largest treated in one season, in more than two decades. This increase can be attributed to the aerial application of antibiotics to control blister rust on western white pine.

Field organization consisted of six base and four spike camps. Four of the base camps worked primarily on National Forest lands and the remaining two worked on state and private lands. Camps were established in the Musselshell, Sheep Mountain, Orofino and Moose Creek areas on National Forest lands. Snake Creek and Headquarters camps worked on state and private lands. The spike camps established were at heliports and served aerial spray crews. Labor turnover was below average and quality of labor was higher than the past several seasons. Camp organization was similar to last season starting with 30 men and dropping to 25 as the season progressed.

Work on state and private lands was limited to the application of antibiotics by hand and aerial methods in the 21 to 40 and 41 to 60 age classes. No ribes eradication work was done. Most of the hand antibiotic work was in the younger age class, and the aerial work was done in the older age class. Treatment was completed in the Cardiff unit and continued in the Jaype, Hildebrand and Powderhouse units. Hand treatment was started in the Snake Creek unit.

Only one of the four base camps working on National Forest lands did antibiotic work. The Musselshell Camp hand-treated reproduction stands adjacent to the camp and retreated the Johnson Draw, Deer Creek and Sec. 31 plantations. Examination of these plantations indicated that results obtained from the original treatment were not acceptable. It was determined that inclement weather conditions during the period of application caused the poor results.

Ribes eradication work was continued in the Osier Creek clear-cut blocks. The first working of stream type was completed and upland eradication was started. The earliest controlled-burn block is now ready to be planted to white pine. Eradication work was continued in the Orofino Creek and Sheep Mountain units where new stands are being regenerated naturally. Additional eradication work is scheduled for these units next season to protect the reproduction now being established on these areas. Power-spray equipment was used to advantage for roadside treatment of large concentrations of small ribes in the Sheep Mountain unit.

Aerial application of antibiotics was continued in the high-value white pine pole stands on state, private and Federal lands. Stands were aerially sprayed on National Forest lands in the Rosebud, Armstrong, Orofino Creek, Hildebrand, Jaype, and Cardiff units during the spring and in the Fan, Beaver, Alder, Deadwood, Osier, and China Creek units during the fall.

Selected state and private stands within the Scofield and East Fork Beaver Creek drainages were also aerially treated. Eight heliports were constructed during the season to facilitate aerial spray operations. Temporary tent or spike camps for aerial spray operations were moved four times during spraying operations. These camps were placed on or immediately adjacent to the heliports to provide security and eliminate travel.

Surveys for determining areas suitable for antibiotic treatment, control effectiveness, ribes populations, and damage in mature stands were completed on more than 75,000 acres.

Eighty-nine trees were reevaluated in the Skull Creek drainage 4 years after the mature damage evaluation of 1958. These samples were taken to check the accuracy of trends predicted at that time. The two charts show comparisons between 1958 predictions and what actually occurred through 1962 for tree deaths (fig. 1) and top flagging of trees (fig. 2). These comparisons show that 1958 estimates were conservative. Mortality and severe damage is occurring at a more rapid rate than predicted. The charts indicate that the time left to act before peak losses occur is approaching one-third again as fast as predicted in 1958. Figure 3 shows the mean annual growth curve for white pine in the North Fork Working Circle. The Skull Creek stand is part of this Working Circle and its present position on the growth curve is indicated.

Construction was started in June on a new BRC warehouse and barracks at the Pierce Ranger Station. Both buildings were completed and accepted in November 1962.

Check trees have now been located and permanently marked on all areas treated with antibiotics. These trees will be examined periodically to determine effectiveness of treatment or need for retreatment.

Approximately 1,200 more acres were prescribed burned within white pine management units on the Pierce, Kelly Creek and Canyon Ranger Districts. Burning conditions were excellent and satisfactory results were obtained on all areas.

Loss to firefighting duties was negligible this season and did not materially affect the control program.

During the 1962 season the project was charged with 5 non-lost time, 7 lost time and 2 vehicle accidents for a total of 14 accidents.

Gerald C. Franc was transferred from the Kootenai National Forest in June to assume duties of project assistant.

COEUR D'ALENE NATIONAL FOREST

Aerial application of antibiotics for the control of white pine blister rust was increased during 1962, with a corresponding decrease in basal stem application. Ribes eradication was continued at about the same level.

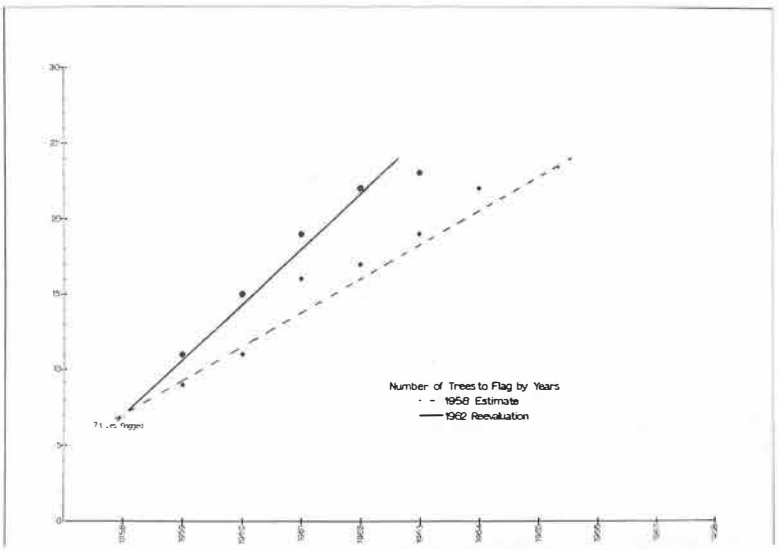


Figure 1.--A comparison of the estimated years to flagging for 34 mature Skull Creek white pine based on 1958 and 1962 surveys.

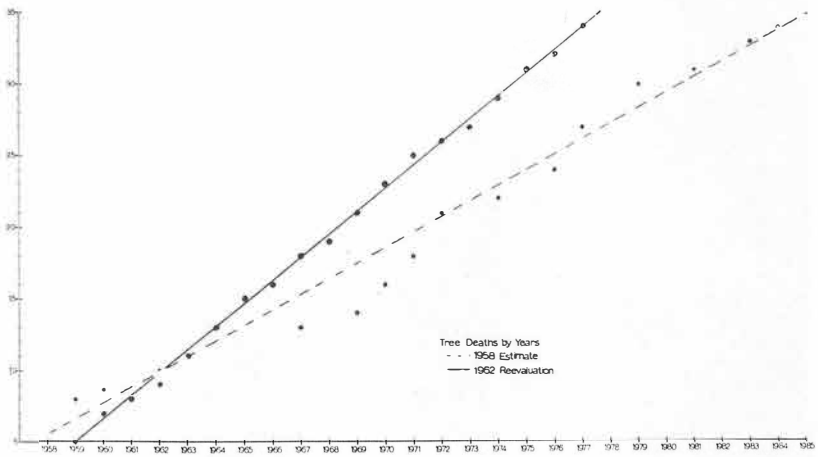


Figure 2.--A comparison of the estimated years to death for the same 34 Skull Creek white pine shows that the stand is going out faster than the 1958 estimate predicted.

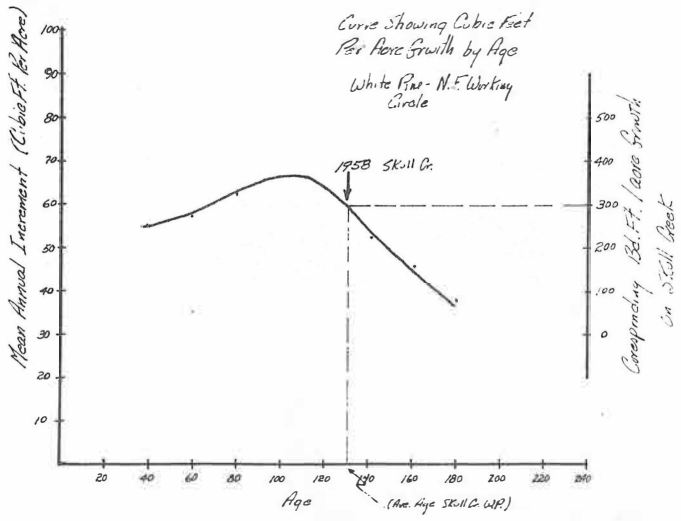
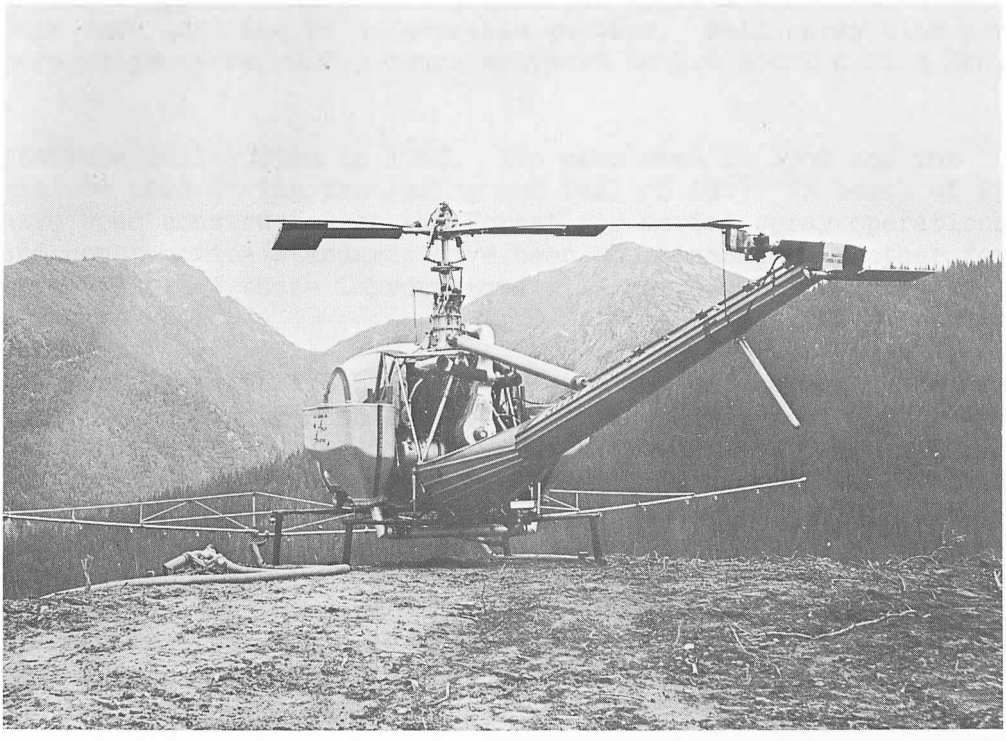


Figure 3.--This graph, taken from the Basic Timber Inventory Data for the North Fork Working Circle, shows mean annual growth of white pine at various age classes.

Typical top-killing in mature trees by white pine blister rust.

Typical top-killing by white pine blister rust in unprotected mature stands. Clearwater National Forest.



Hiller Model 12-E equipped for spraying. Note front-mounted spray boom. Clearwater National Forest.

The seasonal labor force was reduced to 85 men, compared to 135 in 1961, and 180 in 1960, which reflects the increase in aerial application of antibiotics. Accomplishments per man increased considerably over 1961 due to the reduced drain by fire suppression activities. Eleven percent of the possible effective man-days was expended on fire suppression in 1962, compared to 48 percent in 1961.

Field crews were stationed at four camps: Hudlow, Potter Creek, Trail Creek and Shoshone. The Hudlow crew eradicated ribes on the new white pine plantation in the Flora Miller Hill prescribed-burn area. Antibiotic treatment of pole and reproduction stands was continued in the Burnt Cabin and Iron Creek management units. The Potter Creek crew hand-pulled and sprayed ribes throughout the season on prescribed-burn areas in the Potter Creek unit. The crew from Trail Creek did reeradication work in the Riley Creek plantation and initial eradication in upper Flat Creek. The Shoshone crew eradicated ribes on a new white pine plantation in the Beetle Creek prescribed-burn area. Antibiotic treatment of small white pine stands around existing and proposed campgrounds was accomplished late in the summer and fall.

Selected white pine stands were aerially sprayed with antibiotics in both spring and fall. The spring spray project started on May 14 and was completed on June 1. Two helicopters sprayed 2,900 acres of 30- to 80-year old white pine plantations and natural stands in the head of the St. Regis River in Montana. The fall aerial spraying started August 29 and terminated October 12. Two helicopters, a G-3 and a G-3B, were used to spray 8,370 acres of natural and planted pole-size white pine. These stands are within eight compartments in the head of the Coeur d'Alene River on the Magee District.

Weather conditions were generally unfavorable for aerial spraying during both the spring and fall operations. During the fall operation 12 out of 40 available days were lost due to unfavorable weather. Fall spray time per day on actual spray days averaged 2.9 hours compared to 3.6 hours during the fall of 1961.

Ten heliports were constructed in 1962. Two were used in 1962 and the remainder will be used during the spring and fall of 1963. A total of 23 heliports have been constructed on the Forest for aerial spray operations. Financing and construction standards have been coordinated with other forest programs to provide that these improvements will serve multifunctional purposes in future years.

A program of seeding and fertilizing for erosion control on the heliports was started in 1962. Eighteen heliports have been seeded to a mixture of smooth brome, hard fescue, western wheat, dutch clover, and black medic grasses at the rate of 10 pounds per acre. Ammonium sulphate was applied at the rate of about 200 pounds per acre.

Fifty thousand acres were surveyed by helicopter to gather information for planning future aerial spraying. Location of heliports, boundaries of white pine areas, access routes, and general disease conditions were mapped from helicopters at a very low-per-acre cost.

Establishment of permanent check strips for evaluation of effectiveness on hand and aerial-sprayed areas was continued. All cankers located on strips established in 1960 and 1961 were reexamined. Canker examinations indicate that, in general, satisfactory results are being accomplished by both hand and aerial antibiotic methods.

Information and education work was carried on through news releases, slide talks and show-me trips for groups and individuals. A large temporary informational sign was constructed and placed at a vantage point on Highway No. 10, near Lookout Pass, overlooking spray operations along the St. Regis River. A forest officer handed out informational material and explained the purpose of the operation during spray periods. Sixty-four cars with 185 people stopped during actual spray operations. Many more stopped during shut-down periods to read the sign and observe the helicopters.

The annual fall blister rust control seminar was held at the Trail Creek Work Center, on the Magee District, during the week of October 15 to 19. Thirty-five people attended. The Regional Office Divisions of Timber Management, and State and Private Forestry, the Intermountain Forest and Range Experiment Station, the National Park Service, and the Coeur d'Alene, Clearwater, Kaniksu, Kootenai and St. Joe Forests were represented.

W. V. Benedict and C. P. Wessela, from the Division of Pest Control in the Washington Office, visited the Forest in September as part of a limited functional inspection of blister rust control activities in the Region.

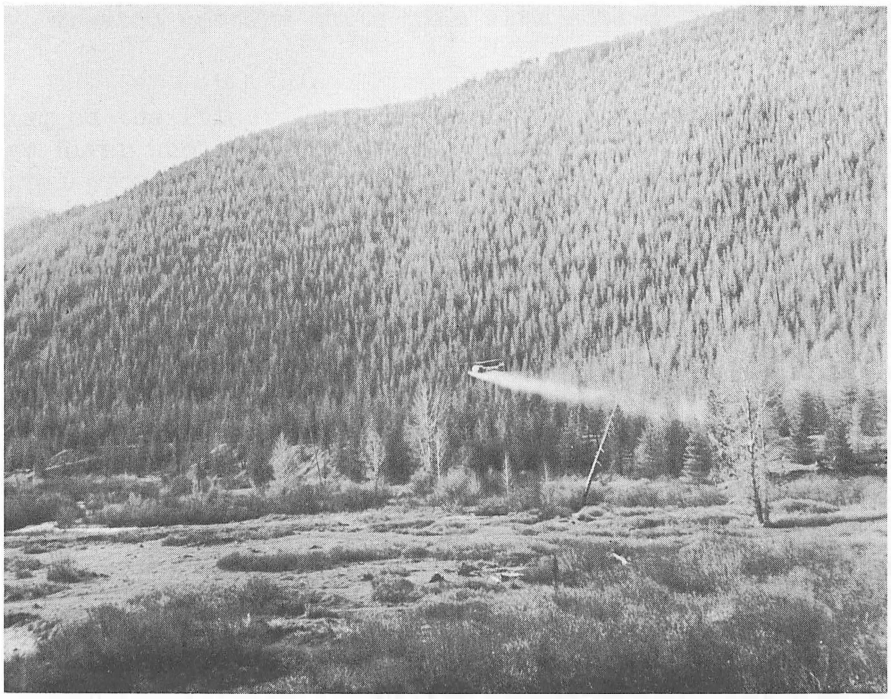
Neil S. Hyde became a permanent member of the blister rust control staff upon graduation from the University of Idaho in June 1962.

Sixty-two thousand man-hours were expended on blister rust control projects from June 1 to November 1, 1962. Seven minor reportable accidents were charged to the project. No lost time or vehicle accidents occurred.

KANIKSU AND COLVILLE NATIONAL FORESTS AND PRIEST LAKE TIMBER PROTECTIVE ASSOCIATION

The application of antibiotics to western white pine continued to be the dominant method of control for blister rust in the Kaniksu and Colville Forests and the adjoining Priest Lake Timber Protective Association. Improved technical knowledge and method developments since this means of control was first used in 1956 permitted direct treatment of immature white pine on 20,230 acres.

The blister rust control organization employed nearly 90 men during the summer field season. Besides the main headquarters camp at Kalispel Bay, there were camps at Beaver Creek and Wylie Creek on the Kaniksu Forest, a camp at Tiger Hill on the Colville Forest and a 10-man haul-out crew which worked on the Association lands. The 10-man Wylie Creek crew sprayed ribes with herbicides on recent clear-cut areas during the first half of the season. During the latter part of the season they basal stem treated a valuable pole-sized stand



Helicopter spraying antibiotic solution on western white pine plantation in Sildex Unit, two miles east of Lookout Pass, Montana. Coeur d'Alene National Forest.

Sildex heliport and equipment. Coeur d'Alene National Forest.

of white pine adjacent to the camp area. Five to eight men also sprayed ribes on a clear-cut on the Priest Lake Ranger District for most of the season. The remaining crews treated western white pine with Acti-dione by the basal stem method.

The crew working on the Priest Lake Timber Protective Association were local men from Priest River who commuted daily. From an administrative standpoint, this organization proved very satisfactory and a substantial savings resulted by not operating a camp.

The entire blister rust control organization was dispatched to two off-forest fires in 1962. Portions of the crew were also used to suppress smaller fires on the Kaniksu. Altogether 430 man-days were spent on fire suppression. A period of rainy weather during July and August, when normally work would be progressing at its peak, was a big problem the past year. Wet weather conditions prevented the camp at Beaver Creek from doing scheduled basal stem treatment during 10 workdays in the month of August alone.

Aerial application of antibiotics began in the middle of May on the Colville Forest where 3,980 acres were sprayed. Excellent spring weather permitted spraying another 3,860 acres on the Priest Lake District. Spraying began on the Noxon District August 28 and due mostly to high winds, 15 days were required to spray 4,020 acres. The unit then sprayed 2,030 acres in Boulder Creek on the Sandpoint District. The fall aerial project was completed in the Upper Priest Lake area where a total of 1,650 acres around Hughes Meadows on National Forest and 1,150 acres in Upper Trapper Creek on Association lands were treated.

A small crew was used during the summer constructing heliports. In cooperation with other forest programs and ranger districts, 22 heliports have now been constructed. These ports have raised landing pads capable of handling two helicopters at the same time. All heliports have been seeded to grass for erosion control.

A large survey and mapping project was begun during the spring aerial spray program. Revised compartment maps with a 4-inch to-the-mile scale and helicopters were used to locate and delineate boundaries of white pine stands needing treatment. Additional maps will be prepared this winter. The survey and mapping of the Forest will be completed in 1963. Two men spent most of the season evaluating results of past antibiotic treatment and setting out sample strips for evaluation of effectiveness in new work areas. A series of plots were established in the Cuban Hill Plantation to test methods and results of using a mechanical scarifier in conjunction with basal stem treatment. The use of scarifiers will provide better penetration of the antibiotics.

A large Accelerated Public Works Program was initiated on the Forest in late October. Use of blister rust control vehicles and other equipment enables the Forest to begin work immediately with a minimum of cost.

Spot planting in the blister rust resistant white pine seed tree orchard at Sandpoint was done to replace trees lost. One man was employed during most of the summer doing the cultivating and weeding around the small trees.

Emphasis on accident prevention was a very important part of the Kaniksu blister rust program. In an effort to effectively get the message to the foreman and crews, a safety committee was formed with members from each camp. Contests, administered by the men, between camp crews and individuals for safe performance, both on and off the job, strengthened the safety program. Three minor accidents occurred.

Don Temple, Unit Supervisor since February 1961, transferred to the Colville District in September. George Leighton returned to the organization in March after military service.

KOOTENAI NATIONAL FOREST

Blister rust control work accomplished this field season was done by the project leader and one man. Control work during 1962 was primarily aerial application of antibiotics, which was done during the first 2 weeks in June. Areas treated were in the Hiatt, Fairway, Club, South Fork Keeler and Thicket drainages. The aerial spray work started in Main Keeler Creek in 1961 was also completed. Good weather conditions prevailed throughout the spray operation. Spray units and operators from other forests were used during the spray period.

Ribes eradication was done on three small clear-cut areas in the Beetle Creek drainage on the Yaak District.

Field checking and aerial surveys were completed on all areas in and out of blister rust control units. Type boundaries were established and the total acreage of treatable white pine and total acres suitable for growing white pine was determined. Programing and planning of work on areas needing treatment has been accomplished.

Preliminary construction work on heliports in the West Fork Quartz, Cyclone, Burnt and Spread Creek drainages was accomplished during the summer.

The operation completed another season without a lost-time accident. Total man-hours worked since the last lost-time accident on July 5, 1951, is 228,192.

ST. JOE NATIONAL FOREST AND POTLATCH TIMBER PROTECTIVE ASSOCIATION

The St. Joe personnel responsible for administering the 1962 National Forest, and State and Private blister rust control programs were: Clyde J. Miller, Staff Officer; Oliver Goldammer and Albert Turner, Unit Supervisors; Forrest Winch, in charge of equipment and supplies; and John Gollaher, in charge of surveys and antibiotic treatment evaluation.

There were 130 workers employed on blister rust control work during the 1962 field season. Eighty employees were stationed in National Forest field camps located at Bussel Creek, Feather Creek, and Clarkia Ranger Station. One 30-man state and private camp was located at Squaw Meadows near Elk River. The four field units hand treated immature white pine stands with the antibiotic, Acti-dione. Workers treated 8,680 acres of Federal, 4,096 acres of state, and 1,434 acres of private lands. There was no ribes eradication work done in 1962.

Phytoactin was aerially applied to 20,100 acres of Federal, 619 acres of state, and 771 acres of private white pine pole stands during May 8 to June 21, and August 27 through October 12. The spring aerial treatment program included the spraying of white pine in the Ramskull-Willow, East Fork Meadow Creek, Meadow Creek, Blair-Cedar, Lower Middle Fork St. Maries River, Flewsie Creek, and Lower West Fork St. Maries River units. The fall spray program included spraying immature white pine in the East Fork Big Creek, Middle Fork Big Creek, Lower Slate Creek, Upper Slate Creek, and Upper North Fork St. Joe River units.

Adverse weather conditions limited the aerial spray time to about 50 percent of possible flight hours. Rain, wind, fog and heat were the main factors restricting the effective spray time.

The aerial spray project used a 10-man portable camp unit for housing and feeding crewmen. The kitchen and messhall were constructed on trailers. The portable units were quickly transported between heliports resulting in the saving of about 50 percent of the man-days previously required to move and establish a standard 10-man tent camp.

The weather during the 1962 work season was again very favorable for the hand application of antibiotics. The season was dry with below average temperatures. The cool season resulted in a reduction of man-days detailed to fire suppression work. The crewmen spent 500 man-days on going fires in 1962, compared to 3,370 man-days in 1961. Only 370 effective control man-days were lost to fire control work in 1962.

All remaining immature white pine stands suitable for hand antibiotic treatment within approved National Forest and state and private white pine management units will be treated during the 1963 field season. Two field camps located at Clarkia and Feather Creek will complete this initial basal stem treatment. A very limited amount of the large white pine acreage outside of approved units is suitable for hand-antibiotic treatment.

One 30-man state and private ribes eradication camp will operate on the East Fork Potlatch Creek during the summer of 1963. Eradication crews will remove ribes in the recent cutover lands near Badger Meadows.

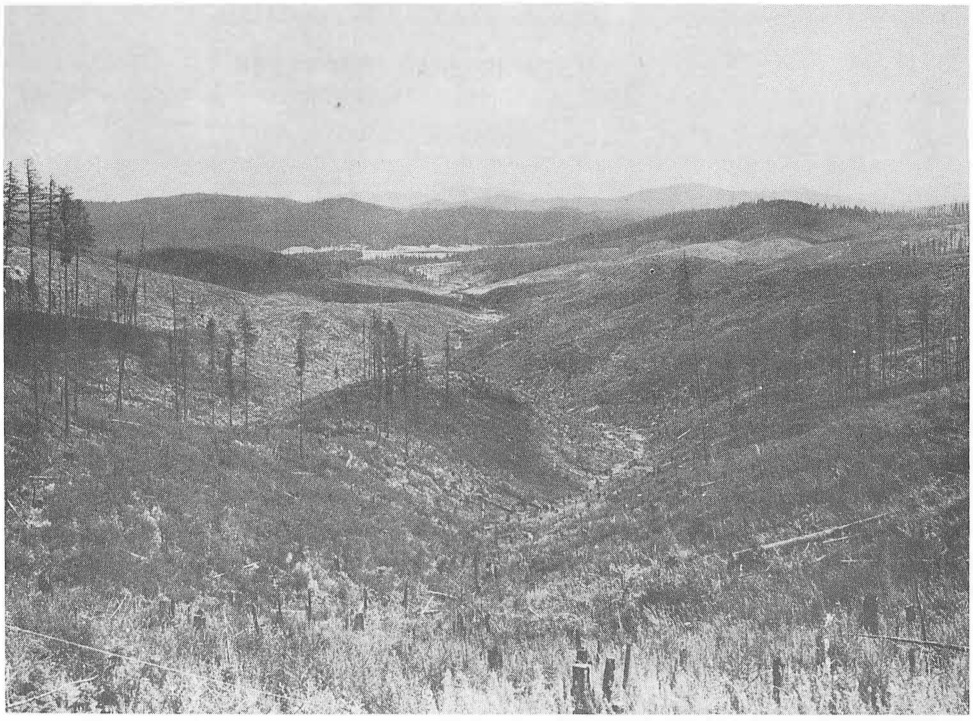
The planned St. Joe blister rust control aerial spray program for 1963 includes the treatment of about 24,000 acres of immature white pine stands on the North Fork St. Joe River, Loop Creek, Clarkia, and North Fork Palouse River units.

St. Joe antibiotic treatment crews have hand treated 31,860 acres of Federal, 12,980 acres of state and 4,010 acres of private immature white pine stands since the first project use of antibiotics for blister rust control in 1958. In addition, helicopters have aerially treated 35,330 acres of Federal, 750 acres of state and 880 acres of private immature white pine stands. A grand total of 85,740 acres of immature white pine have been treated with antibiotics since 1958.

The St. Joe blister rust control personnel are cooperating with timber management foresters in the planning of timber stand improvement projects in the high-value white pine stands on the Ramskull-Willow and Charlie Creek units near Emida, Idaho. The white pine in these units was planted in 1938-1941. The thinning of these stands at this time should result in a continuous maximum growth rate. All of the white pine in these units was treated with antibiotics during the 1959-1961 field season.

The extensive survey for treatable stands of white pine on National Forest, state and private lands was completed during the 1962 season. A 5-man survey crew covered about 240,000 acres in the Calder, Avery, and Red Ives Districts. All of the surveyed areas were outside of the present blister rust control units.

The 1962 St. Joe blister rust control safety program was very effective. The project operated without a lost-time accident and had only one medical case which was classed as occupational. One vehicle was involved in an accident resulting in damage less than $25. The successful safety program was a result of intensive on-the-job safety training of all crewmen and the effective first-aid handling of minor injuries by the camp superintendents.



Ramskull Creek near Emida, Idaho, 1938. Area logged in 1928 and 1929. Snags were felled by CCC's in 1935 and 1936. The slash was burned in 1936 and area planted in 1937 and 1938. St. Joe National Forest.

One of the 1937 western white pine plantations in the above Ramskull drainage. The stand was thinned and pruned during the fall of 1962. The young white pine was treated with the antibiotic, Acti-dione, during the summer of 1959. St. Joe National Forest.

NATIONAL PARK SERVICE

MIDWEST REGION

The 1962 white pine blister rust control program was conducted as provided by provisions of the Lea Act and the 1961 agreement between the U.S. Departments of the Interior and Agriculture. The Forest Service, as in previous years, furnished leadership, coordination, technical direction and pathological evaluations.

For a number of years, both Forest Service and National Park Service personnel responsible for the blister rust control program, have been of the opinion that a regional forestry position should be established in the National Park Service, Midwest Region, to be responsible for all operational activities and the coordinating phases. All concurred that such a position could coordinate the work with other park activities to a higher degree and also give a continuity of leadership to the program within the National Park Service organization.

Such a position was established and became effective July 1, 1962, and John C. Gynn, Forester, Blister Rust Control Staff Specialist, Northern Region, U.S. Forest Service, Missoula, Montana, was transferred to the National Park Service and assigned the Midwest Region White Pine Blister Rust Control Program responsibilities. Mr. Gynn had been performing a considerable amount of the program's operational requirements on a reimbursement basis since 1947, along with the leadership, coordination and technical phases of the program.

In the future, the Forest Service will continue to make available research results and give other assistance as provided in the new agreement between the two agencies.

Personnel Participating

Glacier	C. Donald Barnum, Supervisory Park Ranger in Charge A. D. Cannavina, Assistant Chief Ranger
Yellowstone	Marion W. Myers, Park Forester in Charge John N. Reeves, Forestry Technician, Unit Supervisor
Rocky Mountain	Robert K. Weldon, Park Forester in Charge
National Park Service, Midwest Region	Maynard B. Barrows, Forester
U.S. Forest Service Northern Region	John C. Gynn, Forester in Charge (transferred to National Park Service, Midwest Region, July 1, 1962)
	David A. Graham, Section Head, Blister Rust Control, (after July 1, 1962)

Glacier National Park

No ribes eradication work was performed in 1962. All future programs will probably be based on control by antibiotics.

West of the Continental Divide, a crew of 35 men treated western white pine of all age classes with the antibiotic Acti-dione BR on a total of 1,950 acres in the McDonald Creek, North Fork Road, and West Shore of Lake McDonald units. The 150 ppm formulation of Acti-dione BR (cycloheximide) in No. 1 fuel oil with the surfactant Triton B-1956 added to prevent crystallization was applied by the basal stem method. No mixing or crystallization problems were encountered in 1962. Portable power-driven pumps were used to relay the spray solution across McDonald Creek where bridges were not available and the stream was too wide and deep for fording. The hose lines were suspended over the water and ropes hung from streambank trees. Inspections showed antibiotic treatment results appear normal and are improving with the development of better application techniques. Fire and inclement weather upset working schedules to a considerable extent.

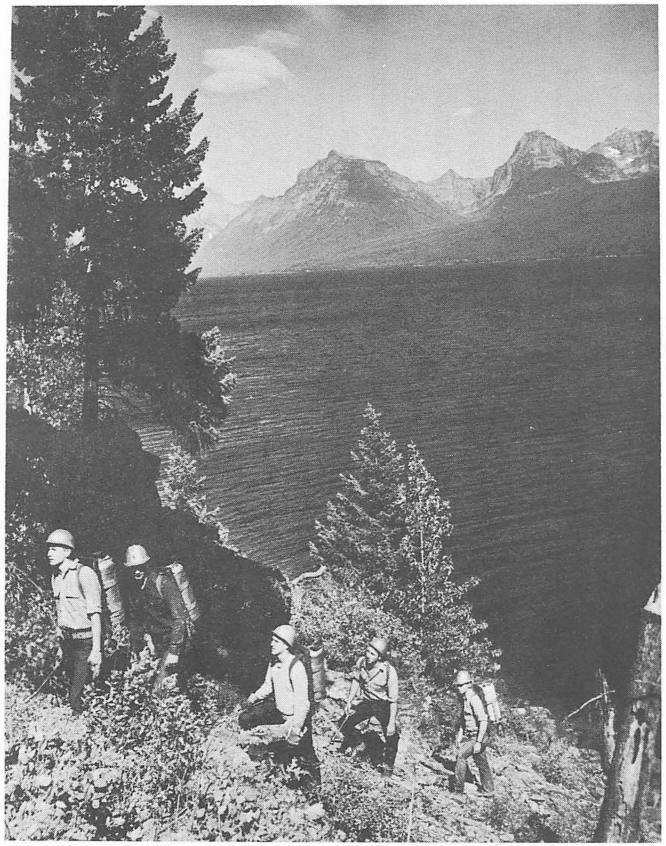
East of the Continental Divide, a crew of 11 men completed a pilot antibiotic (Acti-dione BR) treatment project on the whitebark and limber pine in the Two Medicine Lake area. The Appostekí Falls area, although not scheduled for treatment, was included because it is immediately adjacent to the Two Medicine Lake control unit, and supports a nearly pure stand of unique picturesque, upright and windblown prostrate white pine. Although nearly 100-percent infected, sufficient trees will be saved to retain enough of the natural scene to justify the cost.

All crews assisted park engineers in preparing emergency camp sites for the 1962 flood of camping park visitors.

Yellowstone National Park

All initial, rework, and maintenance ribes eradication goals were achieved on schedule. A total of 1,230 acres of rework and 3,370 acres of initial work were brought to maintenance standards.

All of the 35,730 acres surveyed in 1961 were determined to have high white pine values and were approved for inclusion in the program. The esthetic roadside areas along the Canyon-Norris road, Grand Loop road, Yellowstone Lake shore from Lake Ranger Station to West Thumb, South Gate road from West Thumb to south of Lewis Lake and the visitor development centers at Lake, Bridge Bay, West Thumb, Grant Village and Lewis Lake are included. The areas are scheduled for work by priorities according to pathological factors. No increase in funds will be necessary as this additional work can probably be done within the present fiscal framework of the long-range plan for the Midwest Region.



Crew en route to treatment area. The backpack sprayers are used to apply the antibiotic Acti-dione BR. Lake McDonald, Glacier National Park.

Applying antibiotic solution to infected limber and whitebark pine in test plot on Glen Creek near Mammoth, Yellowstone National Park.

Rocky Mountain National Park

All rework and maintenance ribes eradication goals were achieved or surpassed. All except 380 acres of stream type in the north and south portions of the Longs Peak-Estes Cone and Boulder Brook units is now on a maintenance basis. The only future work scheduled for these areas except random inspections, is a status check in 1963.

Ribes eradication in the proposed additional 4,050-acre Hidden Valley unit has not been initiated.

The crew consisted of seven carefully selected and well-trained men under the direction of a camp superintendent with a number of years of blister rust control supervisory experience. The crew assisted the Ranger Division several times on rescue missions.

Grand Teton National Park

No white pine blister rust control work was performed except for a random inspection of the Snake River-Deadman's Bar control unit, and scouting for the disease. In the vicinity of Surprise and Amphitheatre Lakes, over 400 whitebark pine and 400 ribes were carefully examined for the disease with negative results. However, mountain pine beetle is beginning to spread into these beautiful, high-altitude whitebark pine stands at timber line. In the Jenny Lake area 200 whitebark and limber pine and 150 ribes were examined for rust with negative result. Medium to heavy rust was found on ribes adjacent to the Deadman's Bar control unit in the Snake River stream type. Several limber pine in the control unit died in 1962 from mountain pine beetle attack.

General

Antibiotic Plots

The seven whitebark pine Phytoactin foliar spray plots at Hudson Bay Divide near Glacier National Park were carefully examined. None of the seven formulations have shown much promise to date. The two Phytoactin basal stem plots were also examined and one formulation shows considerable promise. If an early spring inspection verifies the 1962 examination, this formulation can be used instead of Acti-dione BR in 1963. A new whitebark pine foliar spray plot to test the Phytoactin formulation known as L-318, so successfully used in the western white pine helicopter spray projects, was established at Hudson Bay Divide. Discovering a foliar spray that will prove effective in operational use on diseased whitebark and limber pine stands in the parks is paramount.

The many Acti-dione BR plots previously established at Cutbank Ridge and Two Medicine Lake were periodically examined throughout the summer. No significant changes in previously reported results were found.

All antibiotic tests in the parks are designed by Mr. Virgil D. Moss, Chief, Branch of Methods Development and Improvement, Northern Region, U.S. Forest Service, Spokane, Washington.

Surveys

A systematic whitebark-limber pine distribution and disease survey was made on 4,140 acres in the Preston Park and north side of St. Maries Lake areas in Glacier National Park. The object of the survey was to determine the feasibility of control by aerial spraying when an antibiotic foliar spray formulation is discovered that can be used effectively on whitebark and limber pine.

The white pine ribes distribution survey in Yellowstone National Park started in 1961 was extended to include 19,810 additional acres.

Observations

In Yellowstone National Park, 1962 random inspections showed the disease is rapidly intensifying on white pine and ribes in the Glen Creek drainage. For the first time the disease was found on white pine in the vicinity of Sportsman Lake and on ribes in the Antelope Creek drainage.

The initial heavy-ribes areas treated with hormone sprays (2,4,5-T) in Yellowstone and Rocky Mountain National Parks in previous years, were inspected. Results are excellent. Now, it is difficult to find where the original concentrations were growing. In the Rocky Mountain units, ribes seed germination seldom occurs after ribes concentrations have been eliminated by hormone chemicals.

Field Trips and Meetings

The following men attended white pine blister rust control meetings and/or made inspection trips on control areas in one or more of the National Parks - Glacier, Yellowstone, Grand Teton and Rocky Mountain:

U.S. National Park Service

Lawrence F. Cook, Chief of Ranger Services, Washington, D.C.
Robert H. Sharp, Forester, Washington, D.C.
Howard W. Baker, Director, Midwest Region, Omaha, Nebraska
Frand W. Childs, Regional Chief of Ranger Services, Midwest Region (retired September 1962)
Duane D. Jacobs, Regional Chief of Ranger Services, Midwest Region (after September 1962)
Ernest K. Field, Regional Chief of Park Protection, Midwest Region (to June 1962)
Fred F. Dickison, Regional Chief of Park Protection, Midwest Region (after June 1962)

U.S. Forest Service, Northern Region

Homer J. Hartman, Chief, Branch Forest Pest Control, Division of State and Private Forestry, Missoula, Montana

Henry J. Viche, Head, Blister Rust Control Section, Branch of Forest Pest Control (to May 1962)

David A. Graham, Head, Blister Rust Control Section, Branch of Forest Pest Control (after May 1962)

Dr. Harvey V. Toko, Head, Disease Detection and Evaluation Section, Branch of Forest Pest Control

Virgil D. Moss, Chief, Branch of Methods Development and Improvement, Division of State and Private Forestry, Spokane, Washington

Wayne E. Bousfield, Forester, Branch of Methods Development and Improvement, Spokane, Washington (Antibiotic Investigation)

II. ANTIBIOTIC DEVELOPMENT AND IMPROVEMENT WORK IN WHITE PINE BLISTER RUST CONTROL - 1962

Field and laboratory activities included: (1) tree-infection examinations to evaluate results in aerial and hand spraying tests, (2) establishment of new plots in aerial and hand spraying, (3) seedling inspection to determine treatment results and establishment of new tests in the nursery and out-planting site to immunize western white pine planting stock against blister rust infections, (4) artificial inoculation of western white pine in the nursery and field to determine protection periods against new blister rust infections resulting from antibiotic treatments, (5) inspection of results and establishment of new tests on whitebark and limber pines in Glacier National Park, (6) collection of foliage samples from trees aerially sprayed and from trees treated by the basal stem method to quantitatively measure absorption, translocation, and persistence of antibiotics, and (7) chromatographic and bioautographic work in the laboratory to quantitatively determine the amount of antibiotic in plant tissue and in spray solutions.

A. Antibiotic Treatment of White Pines

Treatment results in basal stem and aerial spray tests reported are based on macroscopic infection symptoms and host characteristics associated with live and dead cankers. Infections are determined to be alive if one or more of the following positive live symptoms are present in any degree: (1) aeciospores, (2) pycniospores, (3) bark discoloration, (4) slippage of diseased bark under finger pressure, (5) canker growth as evidenced by advancement of infection, (6) parasitism by the purple mold fungus, Tuberculina maxima, and (7) fresh rodent chewing. Infections are determined to be inactive or dead if one or more of the following negative infection symptoms are present: (1) callus growth and line cracking of bark around infection perimeter, (2) bark brownish-black, shriveled, and sunken to outline the infection margin, (3) recently diseased tissue invaded by saprophytic fungi, plus the absence of all live characteristics listed above. Evaluations are confined to dominant and codominant trees with one or more obviously live bole infections at time of treatment. These are all permanently marked and evaluated at subsequent examinations.

1. Aerial spraying.

a. Status of 1959 tests.

Infection status on crop trees (dominant and codominant) 1, 2, and 3 years after helicopter spraying Phytoactin aqueous solution on 25- and 50-year-old western white pine stands in the St. Joe National Forest is shown in Table 1. Plot treatments and results have been previously discussed in 1959, 1960 and 1961 annual reports.

Number of cankers with live infection symptoms in plots sprayed with Phytoactin 200 ppm and 400 ppm has decreased each year since spraying. In plots sprayed with Phytoactin 100 ppm, number of live infections has slightly increased. These additions

have been based on evidence of fresh rodent chewing and spots of bark discoloration earlier obscured by pitch flow from the canker margin. Infections on the untreated trees have continued to sporulate and prominantly display other symptoms of live infection.

Table 1.--Crop tree results 1, 2 and 3 years after helicopter spraying Phytoactin aqueous solution on 25- and 50-year-old western white pine stands, June 2-3, 1959, St. Joe National Forest

Plot No	Stand age years	Phytoactin water carrier ppm	Percent crop tree infections with negative symptoms		
			Years after spraying		
			1	2	3
1	50	100	49	76	74
2		200	44	77	79
3		400	47	72	76
C1		0	0	3	7
9	25	100	36	71	64
7		200	47	75	76
8		400	40	68	71
C2		0	0	2	2

b. Status of 1960 tests.

Spring tests: Infection status on crop trees (dominant and codominant) 1 and 2 years after helicopter spraying Phytoactin and cycloheximide derivatives on 50-year-old western white pine in the St. Joe National Forest is shown in Table 2. Plot treatments and first-year results have been previously discussed in 1960 and 1961 annual reports.

Phytoactin results in most plots continued to improve. The least effective formulation was L-395. Phytoactin L-395 is formulated with fuel oil and the mixture added to water to prepare a 20-percent oil emulsion. Differences in results of other Phytoactin formulae is largely attributed to variances in spray coverage. Phytoactin L-318, L-382 and L-387 are all water soluble formulations of the antibiotic. Cycloheximide, semicarbazone and thiosemicarbazone proved too phytotoxic to western white pine in aerial spraying. Both caused trees to cast all 2- and 3-year-old needles. Cycloheximide and methylhydrazone production is reportedly too costly to compete with Phytoactin in aerial spraying. Rodent chewing of cankers was less than 5 percent in the sprayed areas. In contrast, 43 percent of the cankers had been freshly chewed in the unsprayed control area.

Table 2.--Crop tree results 1 and 2 years after helicopter spraying antibiotics on 50-year-old western white pine, May 23-28, 1960, St. Joe National Forest

Plot No.	Foliage spray formulations				Percent crop tree infections with negative symptoms	
					Years after spraying	
	Antibiotic	Carrier	Grams per acre	Gallons per acre	1	2
	Phytoactin					
22	L-318	water	7.6	5	37	59
23	L-318	10% oil	7.6	5	69	61
24	L-318	20% oil	7.6	5	68	64
15	L-318	water	7.6	10	51	56
16	L-318	10% oil	7.6	10	59	55
17	L-318	20% oil	7.6	10	66	59
18	L-382	20% oil	7.6	10	75	75
19	L-387	20% oil	7.6	10	33	64
20	L-390	20% oil	7.6	10	52	66
21	L-395	20% oil	7.6	10	33	46
25	Methyl-hydrazone	20% oil	3.8	10	44	45
27	Methyl-hydrazone	20% oil	7.6	10	63	66
27	Methyl-hydrazone	20% oil	15.2	10	69	61
26	Thiosemi-carbazone	20% oil	7.6	10	47	67
29	Semicarbazone	20% oil	7.6	10	69	66
C1	Control	0	0.0	0	0	7

Fall tests: Biological action of the antibiotics on lethal stem infections continued into the second year after spraying. In Phytoactin plots, active perimeter of residual live infections has been largely reduced to small spots of discoloration. Outer margins of the spots on trees selected for inspection have been marked by straight pins to observe the subsequent status of discoloration development. Evidence of an accumulation of enough Phytoactin around the canker margin to be toxic to the cuticle was observed this season. This phenomenon is believed responsible for the continued action of the antibiotic in retarding further growth advancement and destroying remnants of discoloration around the infected perimeter. Phytoactin L-318 water-soluble formulation has been more effective in the 2 years after spraying than Phytoactin L-395 oil soluble formulations.

Cycloheximide, semicarbazone, and methylhydrazone were also applied. Semicarbazone was phytotoxic to western white pine in all tests. Biological action of the two derivatives of cycloheximide has been highly variable on adjacent trees. Antibiotic effects on the infections throughout the plots ranges from no action to complete necrosis. On those infections where complete

necrosis did not occur, there has been no retardation of discoloration advancement. For the most part, fruiting of these residual live infections has been normal each year after spraying. Plots will be reexamined and results of all fall spraying tests reported in 1964.

c. Status of 1961 tests.

Spring and fall aerial spray tests with helicopters were made on the Coeur d'Alene National Forest. In the spring, cycloheximide and methylhydrazone (Lot No. 13,772) was applied to a plot of pole-size western white pine. Two Phytoactin plots were sprayed in the fall. Phytoactin L-318 aqueous solution was applied at the rate of 5 grams active material per acre on one plot and 7.5 grams per acre on another. In the latter test, Multi-Film L was substituted for fuel oil in the preparation of spray solution. Evidence of biological action in both Phytoactin plots was significant this year. Both spring and fall tests will be examined annually and the final results reported in 1964.

d. New 1962 tests.

Two Phytoactin plots were sprayed with helicopters in the fall on the Coeur d'Alene National Forest. Both are in pole-size western white pine stands. Spray-Tac as a wetting agent was substituted for fuel oil in the preparation of the Phytoactin L-318 spray solution applied on one plot. On the other plot, volume of the standard 20-percent oil emulsion spray solution applied was doubled. The plot was flown twice at opposite directions in applying 14 gallons of solution per acre. Plot treatment and selection of inspection trees for evaluation purposes was accomplished by blister rust control personnel on the Forest.

2. Basal stem method.

a. Status of 1960 and 1961 tests.

Tests in the followup treatment of residual live cankers after initial treatment in 1959 in the Lone Cabin Creek drainage, Coeur d'Alene National Forest, were examined for the second year after spraying. Acti-dione BR, 150 ppm, diluted in No. 1 fuel oil was applied with and without Triton B-1956. This surfactant in oil is employed to prevent cycloheximide crystallization.

treatment procedures for the study are described in the 1961 annual report, page 23. Results in the followup treatment of residual live infections 2 years after applying Acti-dione BR, with and without Triton B-1956 in No. 1 fuel oil, are as follows:

Formulation	Crop tree basis infections dead Percent
Acti-dione BR, 150 ppm, diluted in No. 1 fuel oil.	65
Acti-dione BR, 150 ppm, in No. 1 fuel oil with Triton B-1956, .25 of 1 percent	84

Moisture on trunks and its effect on Acti-dione treatment by the basal stem method was studied in 1961. To simulate rain, tree trunks were wet with water before spraying and/or after spraying. Four treatment conditions were simulated: (1) trunk surface dry when treated, (2) trunk surface dry when treated then sprayed with water to simulate rain following treatment, (3) trunk wet with water then sprayed with Acti-dione to simulate rain before treatment, and (4) trunk sprayed with water before and after applying Acti-dione to simulate rainy conditions at the time of treatment. Methods and procedures used in the test are described in the 1961 annual report, page 25. First-year results indicate that Acti-dione oil solution must not be applied to trees when trunk surface is wet from dew, rain or snow. In this test, Acti-dione BR, 150 ppm, was applied in No. 1 fuel oil containing the surfactant Triton B-1956 to prevent cycloheximide crystallization. All infections evaluated were treated directly.

Trunk surface treatment	First-year results crop tree basis infections dead Percent
Dry-treat	52
Dry-treat-wet	23
Wet-treat	0
Wet-treat-wet	0
Untreated	0

Acti-dione, Naramycin (Hercules Powder Company), and Phytoactin antibiotics diluted in No. 1 fuel oil were applied both in the spring and in the fall seasons of 1961 to 15-year-old western white pine on the St. Joe National Forest. Acti-dione was applied as a standard spray solution in which the concentrate was diluted in No. 1 fuel oil containing .25 of 1 percent Triton B-1956. Naramycin was prepared with and without Triton B-1956 additive in No. 1 fuel oil. The three Phytoactin formulations were first

dissolved in the cosolvent, isopropyl alcohol, and the mixture diluted in No. 1 fuel oil. First-year results upon examining plots in August 1962 are shown in Table 3. Biological action of the antibiotics on the diseased trees sprayed in September 1961 is 3 months behind trees sprayed in June 1961. The trees treated on June 15, 1961, were examined during June 1962. The trees treated on September 15, 1961, were examined during September 1962.

Table 3.--First-year results in applying several antibiotics in the spring and in the fall seasons by the basal stem method to 15-year-old western white pine on the St. Joe National Forest

Antibiotic formulation 1/	Ppm	Percent lethal infections with negative symptoms one year after spraying	
		Treatment date	
		June 15, 1961	September 15, 1961
Acti-dione + Triton B-1956	150	83	26
Naramycin	150	95	24
Naramycin + Triton B-1956	150	88	49
Cycloheximide 3x	150	94	2/
Phytoactin L-426	150	57	32
Phytoactin L-318	200	50	24
Phytoactin L-427	250	55	32

1/ Phytoactin formulations were first dissolved in a cosolvent (isopropyl alcohol) before adding the mixture to No. 1 fuel oil.
2/ Plot was not examined in September.

b. New 1962 tests.

Studies on followup application of antibiotics were initiated to develop methods for the retreatment of stands in which first working results are not satisfactory. Acti-dione prepared as a standard spray solution and Phytoactin formulations L-439 and L-440 were tested. The two Phytoactin formulations were directly soluble in No. 1 fuel oil and were prepared as follows:

L-439 and L-440, 2 and 3 fluid ounces of concentrate per gallon of No. 1 fuel oil, respectively. Spray solution was applied to tree trunks with and without the scarification of bark around

the canker perimeter. Thirty pole-size western white pine per plot were treated. These trees were first sprayed in 1959 before No. 1 fuel oil was amended with Triton B-1956 to prevent cycloheximide crystallization. Plots are located in the Kalispell Creek drainage, Kaniksu National Forest. Preliminary results will be reported in 1964.

Venturicidin, a new antibiotic, was field tested in spraying the trunks of pole-size western white pine on the Clearwater National Forest. An experimental formulation, coded TD-433 (Pennsalt Chemicals Corporation) was diluted in water and applied by the basal stem method. The bark around the perimeter of canker margins was slit by a hatchet to facilitate penetration. The antibiotic will be further tested by the basal stem method in 1963.

3. Seedling and Reproduction Treatments.

a. Status of 1961 nursery tests.

In May 1961, a statistically designed test in antibiotic treatment to protect nursery grown seedlings against blister rust infections when outplanted, was started at the Coeur d'Alene Nursery. Phytoactin, 100, 200 and 300 ppm, with and without 0.1 of 1 percent Triton X-155, was applied as an aqueous foliar spray. Four spray schedules, June; June and September; June, July and September; and September, were made to compare season of application. All treated trees were artificially inoculated in October 1961 and again in September 1962. Results after one inoculation, Table 4, are as follows:

(1) Forty-eight percent of the controls became infected.

(2) Treatments applied only in June offered no protection.

(3) Treatments applied three times gave the highest protection. Three applications of concentrations of 200 and 300 ppm resulted in no infected seedlings.

(4) As the concentration of Phytoactin was increased, the number of infected seedlings decreased.

(5) The surfactant alone gave good temporary protection as expected.

(6) No tree mortality or other undesirable side effects have occurred from any treatment.

b. Reproduction tests.

Replicated in June and September 1961, Phytoactin 100, 200 and 300 ppm, aqueous solution, and 10 and 20 percent oil emulsion, were applied to nine 1/10-acre plots supporting natural reproduction size white pine.

Table 4.--Phytoactin foliage spray (water solution) applied to 2-0 western white pine in seedling immunization test

Spray schedule	Phytoactin concentration	Infected seedlings1/		
		Without triton	With2/ triton	Sums
		- - - - Number - - - -		
June	000 ppm	18	11	29
June and September	000 ppm	21	0	21
June, July and September	000 ppm	30	1	31
September	000 ppm	24	7	31
		93	19	112
June	100 ppm	21	18	39
June and September	100 ppm	0	1	1
June, July and September	100 ppm	1	0	1
September	100 ppm	13	3	16
		35	22	57
June	200 ppm	23	23	46
June and September	200 ppm	2	0	2
June, July and September	200 ppm	0	0	0
September	200 ppm	1	0	1
		26	23	49
June	300 ppm	14	18	32
June and September	300 ppm	1	0	1
June, July and September	300 ppm	0	0	0
September	300 ppm	0	1	1
		15	19	34
		169	83	252

1/ September 7, 1962, inspection.
2/ Triton X-155, one-tenth of one percent in aqueous solution.

The purpose of the study is to determine if Phytoactin will control existing infections, and protect trees under 10 years of age against new blister rust infections. Six trees in each of the sprayed plots, and six trees in an unsprayed plot were artificially inoculated under field conditions in September 1961. Observations to date are as follows:

(1) Aeciospore production was less in the treated plots than in the untreated plot.

(2) Existing infection was not controlled at the time cankers were examined during the pycnia season in August.

(3) No new infections were found either on the untreated or on the treated trees.

c. New 1962 tests.

In May, 2,900 western white pine 2-1 seedlings were outplanted near the Mullen tree, Coeur d'Alene National Forest. The purpose of the study is to compare Phytoactin foliar dip treatments, root treatments, and combinations of foliar dips and root treatments as a protectant against blister rust infections. Foliar dip concentrations were 0, 100, 200 and 300 ppm. Emersion periods for foliar dips were 0 (instant), 2.5 minutes, 5 minutes and 10 minutes. Root treatments consisted of a slurry applied to the roots at concentrations of 0, 0.062, 0.125, 0.25, 0.50 and 1.0 percent. In another root treatment test, Phytoactin in pellet form was placed in the bottom of the planting hole. Phytoactin concentrate in the pellets were, no pellets, 15 mg/pellet, 30 mg/pellet, 50 mg/pellet, 75 mg/pellet, 100 mg/pellet, 150 mg/pellet and 200 mg/pellet. Results from this study will not be known until natural infection has occurred.

A general study was made this year to measure the protective ability of different antibiotic treatments against blister rust infections. In the early part of June, 70 white pine trees about 6 years old were transplanted in the Coeur d'Alene Nursery for controlled artificial inoculations. Ten of the trees had already received a field basal stem treatment with Acti-dione in August 1961. The remaining 60 trees were treated in August 1962. The different treatments in the study are listed below.

Antibiotic	Ppm	Carrier	Year	Method of treatment	Number of trees
Acti-dione BR	150	Oil - Triton	1961	Basal stem	10
Acti-dione BR	150	Oil - Triton	1962	Basal stem	10
Phytoactin L-440	200	Oil	1962	Basal stem	5
Phytoactin L-318	200	20% oil emulsion	1962	Foliar spray	10
Phytoactin L-428	-	-	1962	Foliar dust	5
Phleomycin	50	Water	1962	Foliar spray	5
Semicarbazone	50	Water	1962	Foliar spray	5
None	-	Oil - Triton	1962	Basal stem	5
None	-	20% oil emulsion	1962	Foliar spray	5
Untreated	-	-	1962	Untreated	10

All of the trees were artificially inoculated in September 1962. Inoculations will be repeated each year to determine immunity degree and duration for each treatment.

Foliar treatments for natural reproduction areas highly infected with blister rust, but supporting trees too small to be treated with Acti-dione by the basal stem method were further investigated. During a cool period in June, eight 1/10-acre plots of 5- to 10-year-old western white pine were sprayed with Phytoactin L-318 using a power spray unit. Different carriers included 20-percent oil emulsion Multi-Film L, glycerine, and Multi-Film L and glycerine. In the other four plots, trees were given both

a crown drench and a foliar spray. Trees, both with and without infections, were marked for future observations. Other tests on this age class include a foliar drench with Phytoactin L-440 and L-439, and Phytoactin in dust form applied with a small hand duster to a 1/10-acre plot.

4. Laboratory Studies.

a. Aerial spray solution.

In 1961, samples of aerial spray solution were collected from each tank mixture of 900 gallons in spring and fall spraying. The samples were brought into the laboratory for analysis and subsequent study.

Emulsion homogeneity was observed to vary among samples of aerial spray solution prepared with the same oil brand, but different water sources. The following photographs show samples of aerial spray solutions in which Husky Hi-power No. 1 fuel oil was mixed with water from two drainages of close proximity on the Coeur d'Alene National Forest. Water in samples 1 and 2 was obtained from Snow Bird Creek and water in samples 3 and 4 from West Elk Creek. Both drainages are in the northern portion of the McGee Ranger District.

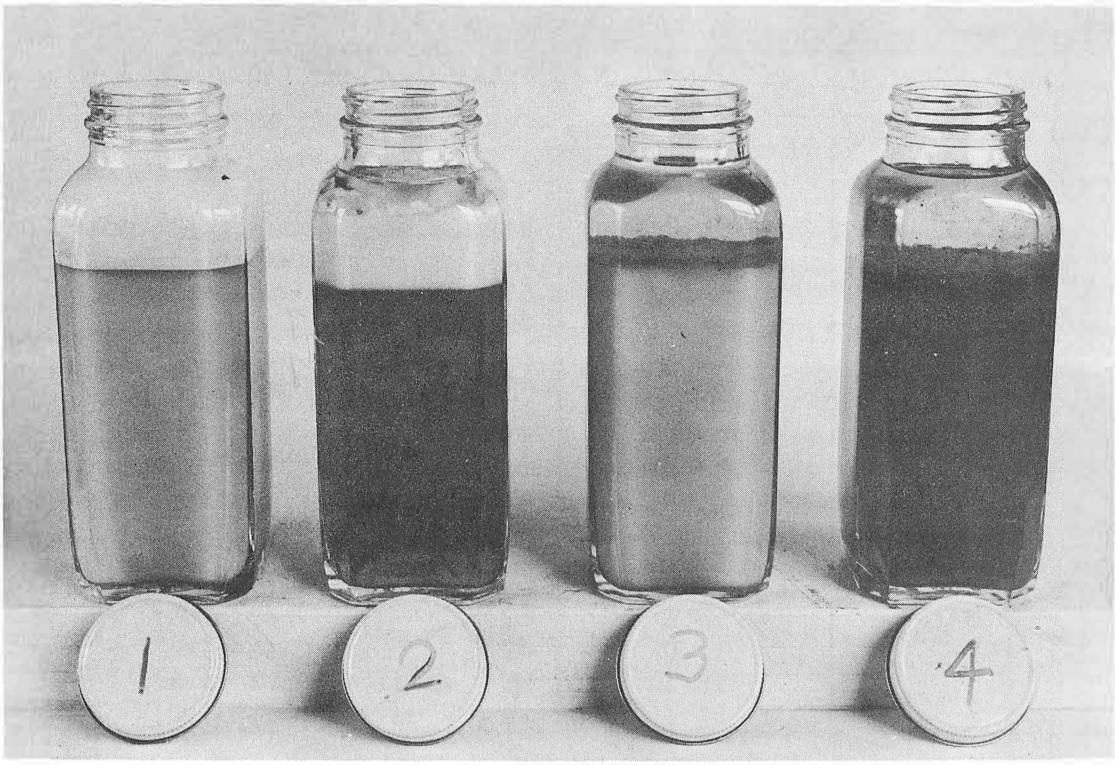
Sample 1 is a stable emulsion and after standing can be homogenized by simple agitation. Sample 2 emulsion has separated into layers of oil and water. Oil and emulsifier are in the top layer and water in the bottom layer. The water is amber in color because it contains the antibiotic. The water used was from Snow Bird Creek.

Both emulsions are completely broken in samples 3 and 4. The nearly limpid layer of pure fuel oil rests on top of the water. In sample 3 the lower layer of water contains both emulsifier and Phytoactin. Sample 4 has lost its emulsifier by decomposition. The water used in these two samples was from West Elk Creek.

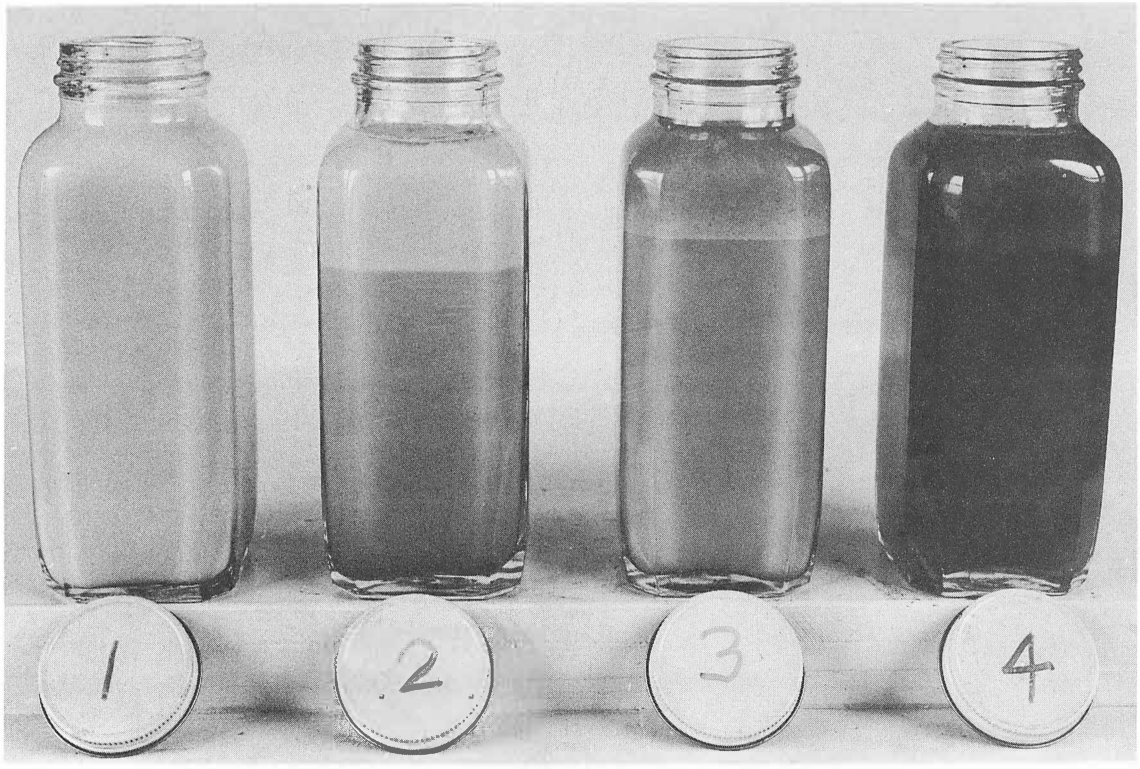
The factor or factors responsible for emulsion separation are not known. Brand of oil and water alkalinity are suspected and are being investigated. Also, studies are in progress to analyze solutions for antibiotic activity in bioautographic methods. The extent to which water in the western white pine region varies in hardness and hydrogen-ion (pH) concentration is demonstrated in Table 5.

b. Phytoactin residue studies.

Needle samples collected from the lower and upper crowns of western white pine sprayed with Phytoactin by the basal stem method were quantitatively analyzed by Pabst Laboratories. Residual Phytoactin detected in the needles over a 7-day period range between treatment and sample collection is shown in Table 6.



Upon settlement for 24 hours, samples show differences occurring in Phytoactin aerial spray final solution prepared from the same oil brands. Husky Hi-power No. 1 fuel oil was used to make these 20-percent oil emulsions.



The same samples shaken and allowed to settle one-half hour. Emulsions 2, 3 and 4 have already separated. Sample 1, similarly shaken, represents the most satisfactory emulsion for aerial spraying.

Table 5.--Total hardness and hydrogen-ion (pH) concentration of some waters in the western white pine region[1/]

Forest	Drainage	Total hardness		Hydrogen-ion (pH) concentration
		Ppm	Grains per Gal.	
Coeur d'Alene	Badger Mountain	14	0.81	7.1
	Lone Cabin	16	0.92	7.1
	Burnt Cabin	18	1.04	7.1
	Mason	24	1.39	7.2
	Shoshone	26	1.50	7.4
	Hamilton	30	1.74	7.4
	Teepee	32	1.85	7.5
	Independence	32	1.85	7.6
	Coeur d'Alene[2/]	34	1.97	7.8
	Snow Peak	34	1.97	7.8
	West Elk	48	2.69	7.7
Kaniksu	Kalispell	20	1.16	6.7
	Granite	28	1.62	6.6
St. Joe	Palouse River	14	0.81	7.4
	East Fork Potlatch	22	1.27	6.8
	St. Maries River	24	1.39	6.7

1/ Coeur d'Alene water samples collected October-November; Kaniksu and St. Joe samples in December.

2/ Coeur d'Alene River water sample was obtained at bridge above mouth of Jordon Creek.

U.S. Forest Service, other than Regional Personnel (Con.)

Russell B. McKennan, General Inspector, Administration, Washington D.C.
Joseph F. Pechanec, Director, Intermountain Forest and Range Experiment Station, Ogden, Utah
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James W. Kimmey, Chief, Forest Disease Research, Ogden, Utah

III. DEVELOPMENT OF BLISTER RUST RESISTANT WHITE PINE - 1962

Our 1960 and 1961 annual reports emphasized the point that a practical product of the cooperative rust-resistance breeding program is in sight. This product is nursery stock, two generations removed from the original resistant parents, about one-half of which should be able to withstand intense exposure to the rust disease. While neither highly resistant nor immune, this stock will become available in time to meet needs of an expanding National Forest planting program. It can be mass produced in grafted seed orchards, initial seed production probably being attained shortly after 1980.

We consider attainment of this practical goal sufficiently important to justify a major shift in program emphasis - from the fundamental research to the developmental aspects of the problem. Originally, the greater portion of our project manpower and dollars was expended on basic research on the "how" and "how much" of inheritance of rust resistance. Now the greater portion of our time and money is being expended on the developmental aspects of the problem, attempting to convert the research findings to practical use.

It is interesting to note that, whereas tests on 40 "wild," canker-free selections and their control-pollinated progenies were sufficient to verify transmission of resistance and to estimate gain in resistance per generation of breeding, about 10 times as many selections must be appraised to meet minimum specifications for a practical seed orchard program. This is mainly because attainment of the practical goal introduces other genetic considerations entirely aside from rust resistance. Foremost of these is the necessity for (1) maintaining a broad genetic base - i.e., a large number of different trees - in seed orchards, to prevent inbreeding and other dangers intrinsic in breeding with restricted populations of trees, and (2) development and maintenance of several genetically distinct lines of white pine, each line adapted for use in a specified elevational planting zone.

In any event, work toward these long-anticipated orchards is finally underway. Two sites, one adjacent to the new Coeur d'Alene Nursery and one on part of the old Savenac Nursery, have been earmarked for seed orchard use. Clearing and irrigation system planning is underway. This winter should see activation of final cooperative seed orchard plans. If work proceeds as now foreseen, planting of specially adapted 3-0 white pine understocks will take place in 1966. Next, in the period 1970-1974, scion-wood from selected, rust-resistant, first-generation trees will be grafted on the pre-established rootstocks.

The final product (resistant, second-generation seed from natural crossing among the grafted first-generation parents) should become available in significant amounts about 1980.

Meanwhile, fundamental research toward provision of still more highly-resistant strains of white pine continues. This work concerns (1) confirmation of predicted gain in resistance between F_1 and F_2 stocks, (2) accumulation of resistance-genes from Eurasian white pines as possible insurance against genetic changes in the rust pathogen, and (3) determination of the underlying mechanical or chemical basis of resistance. In respect to item 3 above, we believe we have uncovered one of the compounds, a phenolic,

associated with resistance. Additional testing will be required, but if confirmatory, the way may be open toward much more economical and rapid testing of seedling resistance.

R. T. Bingham, Project Leader
Intermountain Forest and Range
Experiment Station
Moscow, Idaho

IV. MECHANICAL DEVELOPMENT AND IMPROVEMENTS FOR WHITE PINE BLISTER RUST CONTROL - 1962

A. Mixing-Service Tankers for Antibiotics.

The Region now has six fully-equipped antibiotic mixing-service tankers. These units were converted from military surplus 2,000-gallon semitrailer fuel tankers. One additional tanker is now being converted. These seven units will be sufficient for the aerial spraying by helicopter of about 112,000 acres annually.

B. Mixer-Service Tanker for Power Spraying (Foliage).

A mixer-sprayer suitable for transporting in a truck of 3/4-ton rating was constructed. Its mixing tank has a maximum capacity of 100 gallons.

The tank filling and circulating is done with a 1-1/4-inch tri-rotor pump. Spray ingredients can be metered into the mixer. They may also be metered out if used for small plot aerial spraying.

The barrel-shaped tank is equipped with a paddle agitator. Paddle speed is controlled by a two-stage transmission. Power for the unit is furnished by a single-cylinder Wisconsin electric-start engine.

A John Bean Company two-cylinder, high-pressure pump is attached to the mixing unit. It is fitted with a pressure regulator and bypass, gauge, and three high-pressure hose connections. It is belt-driven and may be operated when foliar spraying is to be done.

C. Truck Slip-on Tanks for Mixer Water Supply.

Five flat-topped, rounded-bottom tanks were constructed of 10-gage steel. The tanks rest on two wood skids. Bolts hold the tank to the skids and the truck bed.

The 3-compartment tanks have a maximum capacity of 900 gallons. Their 30-inch height gives them a low center of gravity. The truck is more easily maneuvered than if loaded with a conventional round tank.

Each of the tanks is supplied with an engine-driven centrifugal pump. This pump unit loads the tank at the stream supply and unloads it at the heliport.

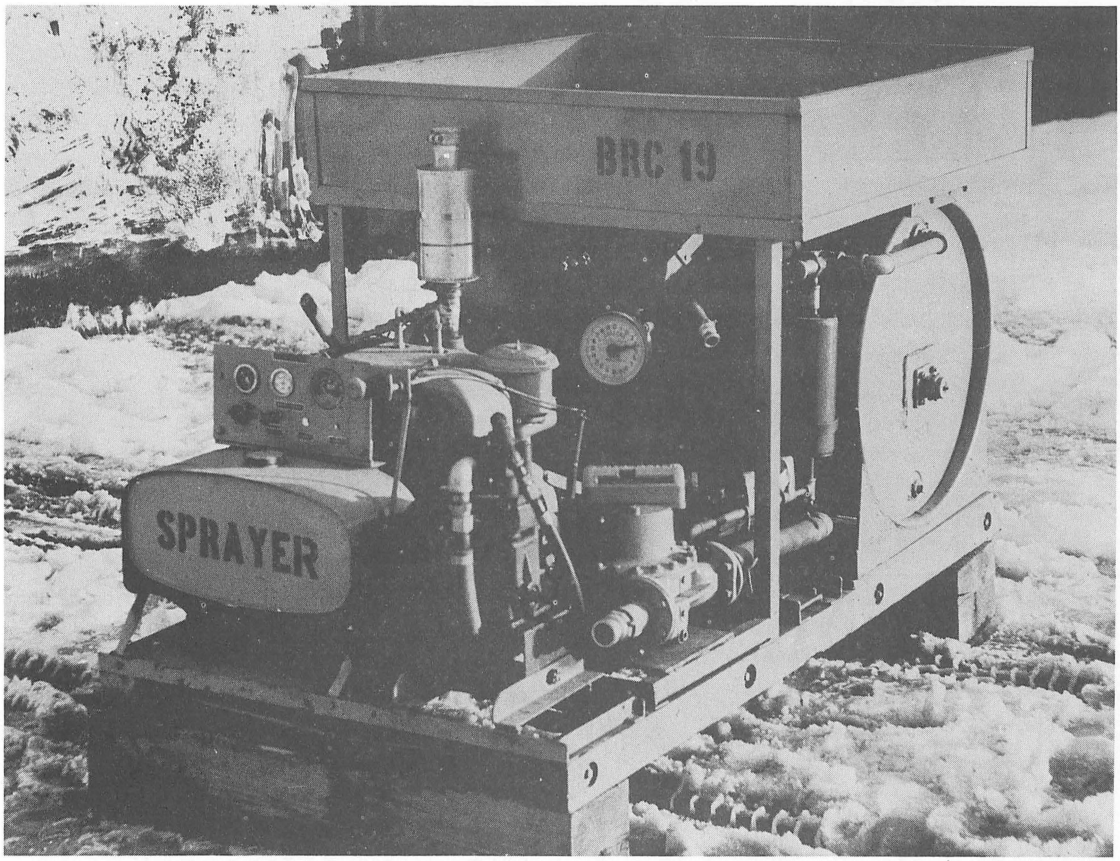
D. Bark Punches and Scarifiers for the Treatment of Diseased Trees by the Basal Stem Method.

The picture chart shows the devices made and given experimental trials during the 1962 field season. Other handtools used were an ice pick, paint scraper, linoleum knife and beverage can opener.

Slitting or creasing the outer bark on white pine trees to increase penetration by antibiotic sprays is important in treating blister rust cankers. Application of the sprays should follow soon after scraping and puncturing of the bark because the wounds close up quickly during the growing season.

Emphasis was placed on the development of a punch and scraper that are fastened to the spray wand. Scraping of the callused bark around the canker, roll-punching the outer area, and spraying the tree trunk must be done in close succession. A single tool to do all three operations in a routine pattern is preferable.

Three dozen tulip-type scarifiers were used on the National Parks. They were lightweight and scraping was difficult. Gouge and roll-punch wands were tested and altered to develop an effective way to increase trunk canker spray penetration. The following picture chart shows the wand that was selected as a model for 1963 field trials. The nine-bark punch places the bark punctures 3/4-inch apart. The scraper and gouge is effective for breaking bark surface around heavily-pitched bole infections.



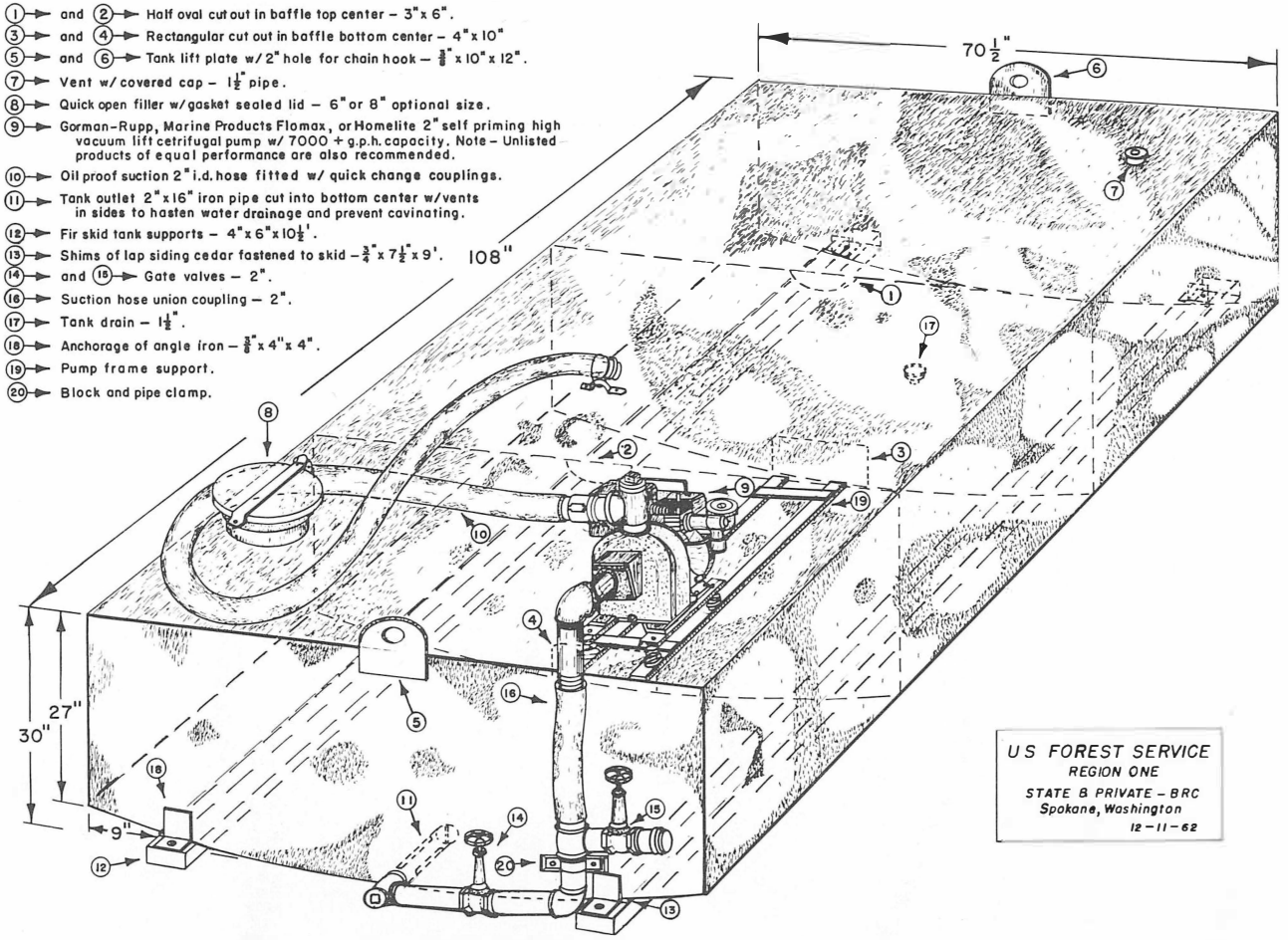
Mixer-Service Tanker for power foliar spraying.

STAKE TRUCK SLIP-ON TANK

CONSTRUCTION– A. Tank with a capacity of 900 gallons. Made of 10 gage arc welded steel with two 12 gage baffles.
B. Tank is mounted on 2 wooden skid plates for anchorage to truck bed.

FEATURES and
ACCESSORIES – – Indicated by numbers ① ► to ⑳ ►

① ► and ② ► Half oval cut out in baffle top center – 3"x 6".
③ ► and ④ ► Rectangular cut out in baffle bottom center – 4"x 10"
⑤ ► and ⑥ ► Tank lift plate w/ 2" hole for chain hook – $\frac{3}{8}$"x 10"x 12".
⑦ ► Vent w/ covered cap – $1\frac{1}{2}$" pipe.
⑧ ► Quick open filler w/ gasket sealed lid – 6" or 8" optional size.
⑨ ► Gorman-Rupp, Marine Products Flomax, or Homelite 2" self priming high vacuum lift cetrifugal pump w/ 7000 + g.p.h. capacity. Note – Unlisted products of equal performance are also recommended.
⑩ ► Oil proof suction 2" i.d. hose fitted w/ quick change couplings.
⑪ ► Tank outlet 2"x 16" iron pipe cut into bottom center w/ vents in sides to hasten water drainage and prevent cavinating.
⑫ ► Fir skid tank supports – 4"x 6"x $10\frac{1}{2}$'.
⑬ ► Shims of lap siding cedar fastened to skid – $\frac{3}{4}$"x $7\frac{1}{2}$"x 9'.
⑭ ► and ⑮ ► Gate valves – 2".
⑯ ► Suction hose union coupling – 2".
⑰ ► Tank drain – $1\frac{1}{2}$".
⑱ ► Anchorage of angle iron – $\frac{3}{8}$"x 4"x 4".
⑲ ► Pump frame support.
⑳ ► Block and pipe clamp.



US FOREST SERVICE
REGION ONE
STATE & PRIVATE – BRC
Spokane, Washington
12-11-62

Truck slip-on tank for supplying antibiotic mixing-service unit.

BARK PUNCHES & SCARIFIERS FOR THE TREATMENT OF DISEASED TREES
3 TOOTH SECTION TAKEN FROM AN 8" CIRCULAR RIP SAW ON 1/8" PIPE WAND
9 BARB 5/16" PIN ROLL PUNCH w/16 G.M.S. BRACES AND 4 POINT S.S. BARK SCRAPER
SPRAY WAND w/ SPUR ROWEL AND C.S. SAW TOOTH SCRAPER WELDED TO ITS UPPER SIDE
SPUR ROWEL AND C.S. SAW TOOTH SCRAPER FITTED TO EACH SIDE OF THE SPRAY WAND
9 BARB 1/4" PIN ROLL PUNCH ON A DORMAN Y-2 BRAKE CLEVIS AND 5 POINT S.S. BARK SCRAPER
2-PIECE BARK SCRAPER AND 16 POINT SPUR ROWEL
#8 5/16" C.S. SAW TOOTH CHISEL ON 1/8" PIPE WAND
ROLL PUNCH OF 18 BARBS w/1/2" PIN, 16 G.M.S. PLATE BRACES, AND 1-PIECE BARK SCRAPER
AN 1/8" BENT PIPE WAND FITTED w/4 BARK PRONGS
2 BAR MEAT TENDERIZER AND DOUBLE SPUR
TULIP SHAPED S.S. CUP ON AN 1/8" PIPE WAND
9 BARB 1/2" PIN ROLL PUNCH w/16 G.M.S. PLATE BRACES AND 6 POINT S.S. BARK SCRAPER
SINGLE BAR MEAT TENDERIZER AND 12 POINT SPUR
16 GAGE x 3/4" x 4" STEEL BEVERAGE CAN OPENER

Bark punches and scarifiers for the treatment of diseased trees.

SPRAY WAND RECOMMENDED FOR FIELD TRIALS IN 1963
The tool shown is a 1/4" x 16" pipe bent 30° 2" from nozzle end. Its handle is a 5/8" I.d. x 6" 2-braid oil-proof hose. The 9-barb roll punch is a No. 2 Huntington carbon steel stone dresser cutter w/ 5/16" center hub of mild steel. Holes in bark are spaced 3/4" apart. A C-2 Dorman brake pin serves as an axle.
There is an iron bridge welded to the top of the wand. Then the 4-point 16 gage stainless steel bark scraper is bolted to the bridge. It serves as an excellent gouge on pitched and callused rust cankers. The 4 No. 10 x 3/8" r.h. machine screws w/hex. nuts permits quick removal.
A Foster quick coupling No. 3003 is attached to the wand. A No. 11-3 plug is fitted to a Hudson No. 4900 trigger control valve. This permits release during extended scarifier activity.

Spray wand recommended for wide-scale field trials in 1963.

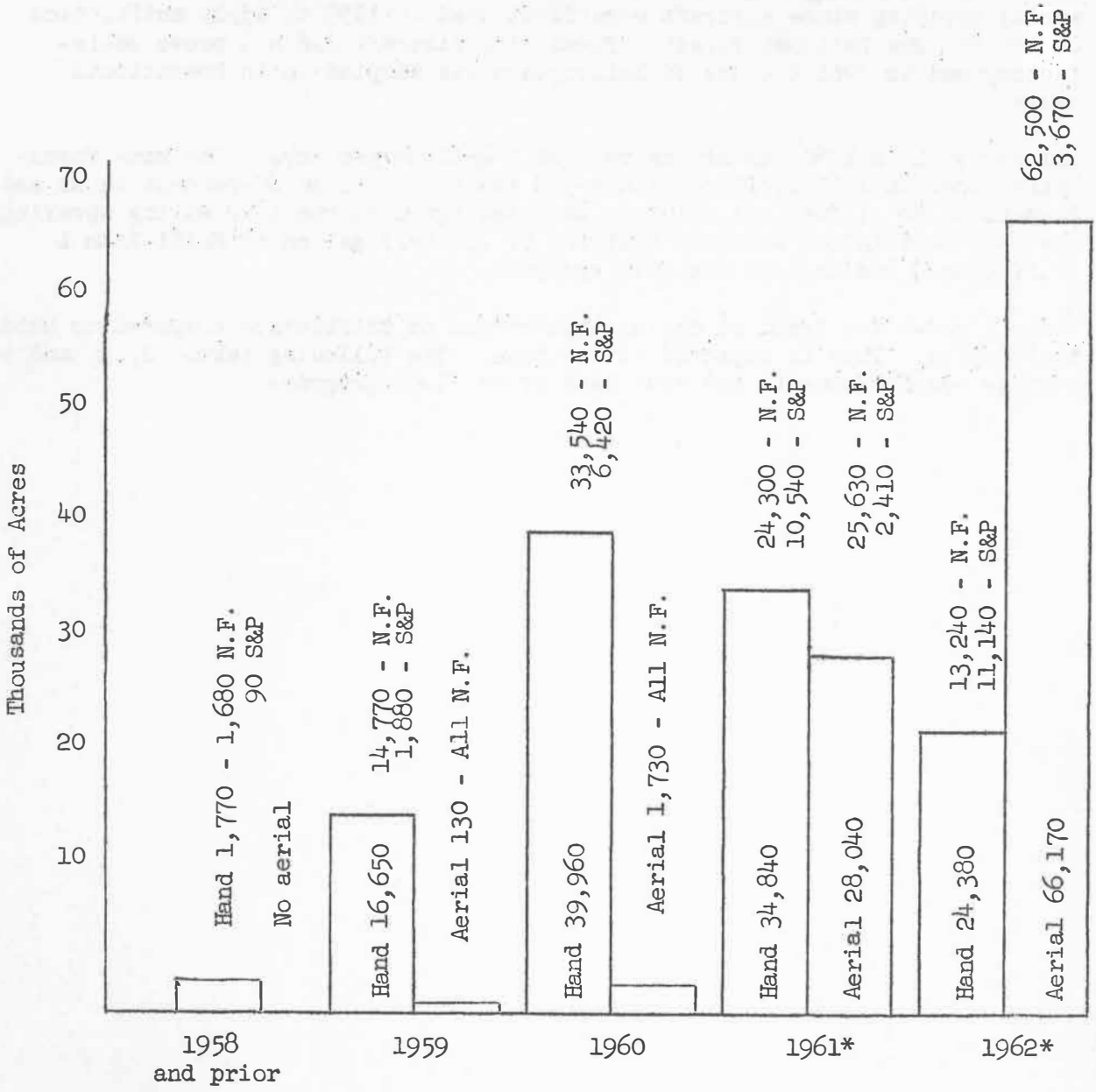
V. AERIAL APPLICATION OF ANTIBIOTICS - 1962

There have been many significant technical and operational changes made in aerial spraying since aircraft were first used in 1959 to apply antibiotics on the St. Joe National Forest. Fixed-wing aircraft did not prove satisfactory and in 1961 the use of helicopters was adopted on an operational basis.

All spraying in 1962 was at the rate of 7 gallons per acre. The same formulation used in 1961 of Phytoactin L-318 emulsified in an 80-percent water and 20-percent No. 1 fuel oil solution was used again in the 1962 spring spraying. The same formulation with the addition of one-half gallon of Multi-Film L (surfactant) was used in the fall spraying.

Table 1 shows the trend of aerial application of antibiotics compared to hand application. This is expected to continue. The following tables 2, 3, and 4 analyze accomplishments and cost data of the 1962 program:

Table 1.--Region 1 Summary of Antibiotic Treatment Through 1962 (National Parks not included)



*These figures include a few areas treated previously where retreatment has been necessary.

Acres treated Federal lands:	Hand	87,530
	Aerial	89,990
	Total	177,520
Acres treated state and private lands:	Hand	30,070
	Aerial	6,080
	Total	36,150
Acres treated by hand methods:		117,600

Table 2.--Summary of 1962 Aerial Spraying by Forests

No.	Item	Forest					Total average
		Clearwater	Coeur d'Alene	Kaniksu	Kootenai	St. Joe	
1.	Acres sprayed	11,890	11,270	16,690	4,830	21,490	66,170
2.	Flight hours - actual spraying	173.7	209.8	242.9	71.4	423.3	1,121.1
3.	Flight hours - orientation	16.0	11.5	13.0	4.8	32.7	78.0
4.	Flight hours - base ferry	11.8	16.3	13.3	5.9	13.4	60.7
5.	Number of spray loads (trips)	1,171	1,189	1,695	440	2,474	6,969
6.	Gallons solution sprayed	86,162	85,160	118,600	34,764	158,611	483,297
7.	Spray trips per hour	6.7	5.7	7.0	6.2	5.8	6.2
8.	Gallons sprayed per hour	496	406	488	486	375	431
9.	Gallons solution per trip	73.5	71.6	70.0	79.0	64.1	69.3
10.	Gallons solution per acre	7.25	7.56	7.11	7.20	7.38	7.30
11.	Acres sprayed per hour - actual time	68.5	53.7	68.7	67.6	50.8	59.0
12.	*Acres sprayed per hour - all time	63.9	47.4	62.0	58.8	45.8	53.2
13.	Average spray time per actual flying workday	2.5	2.4	5.0	2.6	3.4	3.2
14.	Acres sprayed per day - all available workdays in scheduled period	112	105	287	151	132	157
15.	Acres sprayed per day - actual spraying days	171	129	344	177	173	195
16.	Flight hours, other, survey	**	23.0	80.3	12.4	10.9	126.6
17.	Total helicopter use	201.5	260.6	349.5	94.5	480.3	1,386.4

Items 1 through 6, 16 and 17 are totals of all work done during the season by all helicopters.
Items 7 through 15 are calculated on the basis of one helicopter - the average for all used.

*Does not include other survey and mapping time.
**15.5 hours of survey and mapping time included in items 2 and 3.

Table 3.--1962 Aerial Spraying - Helicopter Makes and Models

Item	Helicopter type					Total average
	Bell J. Ranger	Bell Super G-2	Bell G-3	Bell G-313	Hiller 12-E	
Number of aircraft	1	1	2	4	1	
Acres sprayed	490	9,750	15,440	32,500	7,990	66,170
Flight hours - actual spraying	10.8	197.2	303.0	504.8	105.3	1,121.1
Flight hours - orientation	0.5	13.5	24.8	31.0	8.2	78.0
Flight hours - ferry	1.3	7.5	16.0	29.2	6.7	60.7
Number of spray loads	93	1,214	1,674	3,261	727	6,969
Gallons solution sprayed	3,710	70,704	117,076	234,482	57,325	483,297
Spray trips per hour	8.6	6.2	5.5	6.5	6.9	6.2
Gallons sprayed per hour	344	359	386	465	544.4	431
Gallons solution per trip	40.0	58.2	69.9	71.9	78.9	69.3
Gallons solution per acre	7.57	7.25	7.58	7.21	7.17	7.30
Acres sprayed per hour - actual time	45.4	49.4	51.0	64.4	75.9	59.0
*Acres sprayed per hour - all flight time	38.9	44.7	44.9	57.6	66.5	52.5
Number of workdays in period	5	77	140	187	61	470
Number of actual spray days	5	52	101	140	43	341
Average spray time per actual days	2.16	3.79	3.00	3.60	2.45	3.29
Maximum spray time - one day	2.7	7.6	7.8	10.3	5.7	10.3
Minimum spray time - one day	1.1	0.2	0.4	0.4	0.5	0.2
Acres sprayed per day - all days	98.0	126.6	110.3	173.7	131.0	140.8
Acres sprayed per day - actual days	98.0	187.5	152.9	232.0	185.8	194.0
Flight hours, other, survey		5.0	28.9	92.7		126.6
Total use - hours	12.6	223.2	372.7	657.7	120.2	1,386.4

*Does not include other survey and mapping time.

Table 4.--1962 Aerial Spraying - Per Acre Direct Cost Analysis by Forests

Item	Forest					Total
	Clearwater	Coeur d'Alene	Kaniksu	Kootenai	St. Joe	
Acres sprayed	11,890	11,270	16,690	4,830	21,490	66,170
Phytoactin L-318	$6.94	$7.44	$7.04	$7.29	$7.51	$7.24
Helicopter	2.17	2.32	2.14	1.90	2.38	2.18
Salaries (spraying)	.66	.56	.47	.41	.43	.51
Meal subsidy - per diem	.09	.11	.09	.10	.09	.09
Fuel oil	.21	.25	.22	.28	.22	.24
Multi-Film L		.01	.01		.01	.01
Heliport construction	.11	.23	.22	.53	.04	.23
Other - equipment use, camp costs, etc.	.16	.22	.20	.17	.12	.18
Total cost	$10.34	$11.14	$10.39	$10.68	$10.80	$10.68

These costs cover all flying time, including any aerial survey and mapping work done as part of the actual spray job. Other survey and mapping time flown for preparation of future treatment plans is not included.

VI. STATISTICAL TABLES

Statistical tables summarizing accomplishments and expenditures on a calendar year basis for each program and a total of all programs is presented in this section.

An explanation of the tables for the total of all programs follows. The tables for individual programs are similar.

1. Blister Rust Control Expenditures.

   All funds expended in Region 1 including research reimbursement items for developmental work.

2. Field Organization.

   Self-explanatory.

3. Antibiotic Treatment.

   The number of trees treated are determined from random sample plot counts.

4. Total Progress of Ribes Eradication.

   All areas worked either initially or reworked for control are included. The area in Table 7 and all work done with Sale Area Betterment (K-V) funds is included.

5. Surveys.

   a. Type - Ribes. Includes all types of checking, disease surveys, and pre-eradication surveys done for the purpose of ribes eradication.

   b. Type - Antibiotic. Includes all types of survey work done for the purpose of determining areas to be treated with antibiotics. Systematic inspection of treated areas to determine effectiveness is also included. Flying time directly connected with spraying such as ferrying and pilot orientation is not included.

6. Total Effective Blister Rust Control Field Man-Days.

   Only the man-days actually spent in the field on one of the activities listed are included. The man-days for camp construction, camp maintenance, cooks, clerks, warehousemen, mechanics, and truck drivers are not included.

7. Chemical Eradication.

   This table shows the acres sprayed with 2,4,5-T herbicides to eradicate ribes. The application may be from truck-mounted or backpack sprayers. These data are included in Table 4.

8. Net Acres of White Pine by Age Classes.

This table includes all areas satisfactorily stocked with white pine. The areas reported for the National Forest, and the State and Private programs have 20 percent or more white pine stocking. All areas that have been approved for white pine management and those areas where the present stand can be brought through to maturity with the application of antibiotics alone and without ribes eradication are included. Areas of white pine sites presently unsatisfactorily stocked or protection zones are not included. The data reported for the National Forest program includes only National Forest and Public Domain land. The data reported for the State and Private program does not include any Federal land.

9. Accumulative Summary of Antibiotic Treatment.

This table shows the breakdown between the presently approved white pine management units and the areas planned for antibiotic treatment only. Areas outside of the approved units warranting immediate antibiotic treatment are now being treated on a priority basis.

10. Ownership in Blister Rust Control Programs.

The area shown as National Forest program includes only National Forest and Public Domain lands. Only state and private land is included in the State and Private program. Intermingled lands have been separated and are reported in the respective programs solely on the basis of ownership.

White pine management units are those areas that have been approved for the continuous production of western white pine. They are the highest priority units based on volume productivity with ribes eradication that were established following the 1948 and 1949 unit analysis. Additional ribes eradication work will be necessary. Antibiotic treatment will be done where and when necessary.

Areas outside are those established stands outside of approved white pine management units that, by treating existing stocking with antibiotics, could be brought through to a merchantable size. The next crop on these lands will depend on developments in rust-resistant pine, antibiotics and economic changes.

SUMMARY OF ALL PROGRAMS

1. Blister Rust Control Expenditures, Calendar Year 1962

State	U.S. Forest Service Region 1 - Funds (dollars)					National Park Service	State and Private	Total
	720	042	411	K-V	Total			
Idaho	158,778	1,219,584	83,022	119,279	1,580,663		101,323	1,681,986
Mont.	22,202	177,690			199,892	68,144		268,036
Wash.	11,852	127,406			139,258			139,258
Colo.	1,024				1,024	10,191		11,215
Wyo.	6,024				6,024	82,040		88,064
Total	199,880	1,524,680	83,022	119,279	1,926,861	160,375	101,323	2,188,559

720 - Leadership and technical direction for all programs including developmental work.
042 - National Forest program including Regional Office expenditures.
411 - Federal matching funds for State and Private cooperative programs.
K-V - Stand improvement collections used for BRC on National Forest land.

2. Field Organization - 1962

Program	Camps	Employees ribes eradication	Employees antibiotic treatment	Total employees
National Forest	15	175	205	380
National Park	5	61	46	107
State & Private	4		100	100
All programs	24	236	351	587

3. Antibiotic Treatment - 1962

Program	Method	Acres treated	Man-days	Helicopter hours	Trees treated
National Forest	Hand	13,240	6,230		1,466,400
	Aerial	62,500	1,339	1,164.0	9,749,100
	Total	75,740	7,569	1,164.0	11,215,500
National Parks	Hand	2,750	1,940		245,000
State & Private	Hand	11,140	3,850		878,200
	Aerial	3,670	113	80.3	527,700
	Total	14,810	3,963	80.3	1,405,900
All programs	Hand	27,130	12,020		2,589,600
	Aerial	66,170	1,452	1,244.3	10,276,800
	Total	93,300	13,472	1,244.3	12,866,400

SUMMARY OF ALL PROGRAMS

4. Total Progress of Ribes Eradication - 1962

Program	Acres	Man-days	Ribes	Per acre	
				Man-days	Ribes
National Forest	5,645 U	6,848	1,911,710	1.21	339
National Park	11,390	2,570	155,000	0.23	14
State & Private	75	67	3,220	0.90	429
All programs	17,110	9,485	2,069,930	0.55	121

U Plus K-V ??

5. Surveys - 1962

Program	Type	Acres	Man-days	Helicopter hours
National Forest	Ribes	9,620	169	
	Antibiotic	599,540	643	122.2
	Total	609,160	812	122.2
National Park	Ribes	26,880	380	
	Antibiotic	4,140	80	
	Total	31,020	460	
State & Private	Ribes	1,900	10	
	Antibiotic	344,960	176	19.9
	Total	346,860	186	19.9
All programs	Ribes	38,400	559	
	Antibiotic	948,640	899	
	Total	987,040	1,458	142.1

6. Total Effective Blister Rust Control Field Man-days - 1962

Program	Ribes eradication	Antibiotic treatment	Surveys	Total
National Forest	6,848	7,569	812	15,229
National Park	2,570	1,940	460	4,970
State & Private	75	3,963	175	4,213
All programs	9,493	13,472	1,447	24,412

7. Chemical Eradication - 1962

Program	Acres	Man-days	Ribes destroyed	Gallons of spray solution
National Forest	1,175	1,916	1,611,100	234,050
National Park	210	320	74,000	7,430
All programs	1,385	2,236	1,685,100	241,480

8. Net Acres of White Pine by Age Classes - 1962

Program	Age classes by date of origin						Total acres
	1980-1961	1960-1941	1940-1921	1920-1881	1880-1841	1840 & Prior	
National Forest 1/	1,130	27,330	248,200	440,990	112,080	459,870	1,289,600
National Park	- - - - - - - - Not classified - - - - - - - -						99,680
State & Private	1,580	45,500	114,330	191,110	30,450	165,240	548,210
All programs	2,710	72,830	362,530	632,100	142,530	625,110	1,937,490

1/ Includes 19,140 acres of Public Domain.

9. Accumulative Summary of Antibiotic Treatment - 1962

Program	Within white pine management units		Areas outside of white pine management units		Total	
	Total acres	Acres treated to date	Total acres	Acres treated to date	Total acres	Acres treated to date
National Forest	505,650	123,670	783,950	48,520	1,289,600	172,190
National Park	99,680	7,250			99,680	7,250
State & Private	166,340	29,340	381,870	6,810	548,210	36,150
All programs	771,670	160,260	1,165,820	55,330	1,937,490	215,590

10. Ownership in Blister Rust Control Programs - 1962

Program	National Forest acres	National Park acres	Public domain acres	State acres	Private acres	Total acres
National Forest	1,270,460		19,140			1,289,600
National Park		99,680				99,680
State & Private				169,340	378,870	548,210
All programs	1,270,460	99,680	19,140	169,340	378,870	1,937,490

NATIONAL FOREST PROGRAM

Expenditures, Calendar Year 1962

Forest	720 funds	042 funds	K-V funds	Total
Clearwater	$10,099	$230,171	$95,873	$336,143
Coeur d'Alene	28,370	268,154	18,552	315,076
Colville	3,026	108,067		111,093
Kaniksu*	8,778	265,867	4,854	279,499
Kootenai	8,277	64,631		72,908
St. Joe	16,700	428,196		444,896
Total	$75,250	$1,365,086	$119,279	$1,559,615

*Kaniksu National Forest administers the program on the Colville National Forest.

2. Field Organization - 1962

Forest	Camps	Employees ribes eradication	Employees antibiotic treatment	Total employees
Clearwater	4	105	20	125
Coeur d'Alene	4	55	30	85
Colville	1		10	10
Kaniksu	3	15	55	70
Kootenai				
St. Joe	3		90	90
All forests	15	175	205	380

3. Total Progress of Ribes Eradication - 1962

Forest	Acres	Man-days	Ribes	Per acre	
				Man-days	Ribes
Clearwater	3,185	3,810	603,500	1.20	189
Coeur d'Alene	1,850	2,440	978,000	1.30	529
Kaniksu	540	580	330,000	1.07	611
Kootenai	70	18	210	.26	3
All forests	5,645	6,848	1,911,710	1.21	339

4. Antibiotic Treatment - 1962

Forest	Method	Acres treated	Trees treated	Man-days	Helicopter hours	Per acre		
						Trees	Man-days	H. hours
Clearwater	Hand	760	235,200	550		309	.72	
	Aerial	10,760	1,453,000	190	166.0	135		.016
	Total	11,520	1,688,200	740	166.0	147		
Coeur d'Alene	Hand	1,040	203,000	700		195	.67	
	Aerial	11,270	2,635,000	350	237.6	234		.021
	Total	12,310	2,838,000	1,050	237.6	230		
Colville	Hand	720	91,000	340		126	.47	
	Aerial	3,980	696,000	80	70.0	175		.018
	Total	4,700	787,000	420	70.0	167		
Kaniksu	Hand	2,040	399,000	1,490		196	.73	
	Aerial	11,560	2,385,000	281	168.9	206		.015
	Total	13,600	2,784,000	1,771	168.9	205		
Kootenai	Aerial	4,830	976,000	88	82.1	202		.017
St. Joe	Hand	8,680	538,200	3,150		62	.36	
	Aerial	20,100	1,604,100	350	439.4	80		.022
	Total	28,780	2,142,300	3,500	439.4	74		
All forests	Hand	13,240	1,466,400	6,230		111	.47	
	Aerial	62,500	9,749,100	1,339	1,164.0	156		.019
	Total	75,740	11,215,500	7,569	1,164.0	148		

5. Surveys - 1962

Forest	Type	Acres	Man-days	Helicopter hours
Clearwater	Ribes	7,080	35	
	Antibiotic	19,450	40	9.5
	Total	26,530	75	9.5
Coeur d'Alene	Ribes	2,400	130	
	Antibiotic	55,000	150	23.0
	Total	57,400	280	23.0
Colville	Antibiotic	26,550	6	13.6
Kaniksu	Ribes	140	4	
	Antibiotic	135,940	121	58.8
	Total	136,080	125	58.8
Kootenai	Antibiotic	30,000	26	12.4
St. Joe	Antibiotic	332,600	300	4.9
All forests	Ribes	9,620	169	
	Antibiotic	599,540	643	122.2
	Total	609,160	812	122.2

6. Total Effective Blister Rust Control Field Man-days - 1962

Forest	Ribes eradication	Antibiotic treatment	Surveys	Total
Clearwater	3,810	740	75	4,625
Coeur d'Alene	2,440	1,050	280	3,770
Colville		420	6	426
Kaniksu	580	1,771	125	2,476
Kootenai	18	88	26	132
St. Joe		3,500	300	3,800
All forests	6,848	7,569	812	15,299

7. Chemical Eradication - 1962

Forest	Acres	Man-days	Ribes destroyed	Gallons of spray solution	Man-days per acre
Clearwater	390	730	419,000	93,000	1.87
Coeur d'Alene	365	686	902,200	92,850	1.88
Kaniksu	420	500	289,900	48,200	1.19
All forests	1,175	1,916	1,611,100	234,050	1.63

8. K-V Work - 1962 Includes survey acres.

Forest	Ribes eradication		Antibiotic treatment		Total	
	Acres	Man-days	Acres	Man-days	Acres	Man-days
Clearwater	5,030 *	2,570	550	505	5,580	3,075
Coeur d'Alene	1,900 **	860			1,900	860
Kaniksu	100	120			100	120
All forests	(3020) 7,030	3,550	550	505	7,580	4,055

* 2100 acres actually worked
** 820 " "

9. Net Acres of White Pine by Age Classes - Federal Ownership - 1962

Forest	Age classes by date of origin						Total acres
	1980-1961	1960-1941	1940-1921	1920-1881	1880-1841	1840 & Prior	
Clearwater	40	16,270	28,910	50,080	12,600	165,530	273,430
Coeur d'Alene	350	7,790	77,020	144,620	11,690	197,300	438,770
Colville			8,960	12,490	8,680	8,420	38,550
Kaniksu	670	1,300	76,340	151,260	63,760	48,270	341,600
Kootenai	70	1,170	5,270	29,040	450	19,950	55,950
St. Joe		800	51,700	53,500	14,900	20,400	141,300
All forests 1/	1,130	27,330	248,200	440,990	112,080	459,870	1,289,600

1/ Includes 19,140 acres of Public Domain.

NATIONAL FOREST PROGRAM

10. Accumulative Summary of Antibiotic Treatment - All Federal Ownership - 1962

Forest	State	Areas within white pine management units		Areas outside of white pine management units		Total	
		Total acres	Acres treated to date	Total acres	Acres treated to date	Total acres	Acres treated to date
Clearwater	Idaho	162,550	26,010	110,880	590	273,430	26,600
Coeur d'Alene	Idaho	100,650	22,220	317,550	7,230	418,200	29,450
	Montana	10,400	1,230	10,170	1,990	20,570	3,220
	Total	111,050	23,450	327,720	9,220	438,770	32,670
Colville	Wash.	6,920	1,180	31,630	5,330	38,550	6,510
Kaniksu	Idaho	84,320	17,180	139,320	6,540	223,640	23,720
	Montana	10,840	1,270	28,740	2,740	39,580	4,010
	Wash.	25,290	7,530	53,090	1,900	78,380	9,430
	Total	120,450	25,980	221,150	11,180	341,600	37,160
Kootenai	Idaho	5,060	140	330	10	5,390	150
	Montana	37,120	3,800	13,440	4,620	50,560	8,420
	Total	42,180	3,940	13,770	4,630	55,950	8,570
St. Joe	Idaho	62,500	43,110	78,800	17,570	141,300	60,680
Totals	Idaho	415,080	108,660	646,880	31,940	1,061,960	140,600
	Montana	58,360	6,300	52,350	9,350	110,710	15,650
	Wash.	32,210	8,710	84,720	7,230	116,930	15,940
Grand Total		505,650	123,670	783,950	48,520	1,289,600	172,190

STATE AND PRIVATE PROGRAM

1. Expenditures, Calendar Year 1962

Forest	Federal funds			State and private funds			Total all funds
	720	411	Total	State	Private	Total	
Clearwater	$5,049	$40,789	$45,838	$30,341	$10,561	$40,902	$86,740
Kaniksu	1,239	14,444	15,683	13,674		13,674	29,357
St. Joe	8,300	27,789	36,089	34,103	8,644	42,747	78,836
Total	$14,588	$83,022	$97,610	$78,118	$19,205	$97,323	$194,933

Clearwater National Forest administers the Clearwater Timber Protective Association program.
Kaniksu National Forest administers the Priest Lake Timber Protective Association program.
St. Joe National Forest administers the Potlatch Timber Protective Association program.

2. Field Organization - 1962

Forest	Camps	Total employees - all on antibiotic treatment
Clearwater	2	55
Kaniksu	1	10
St. Joe	1	35
All forests	4	100

3. Total Progress of Ribes Eradication - 1962

Forest	Acres	Man-days	Ribes	Per acre	
				Man-days	Ribes
Clearwater	75	67	3,220	.89	429

No chemical eradication was done on state and private lands during 1962.

STATE AND PRIVATE PROGRAM

4. Antibiotic Treatment - 1962

Area	Forest	Method	Acres treated	Trees treated	Man-days	Helicopter hours	Per acre		
							Trees	Man-days	H. hours
Within association white pine management units	Clearwater	Hand	4,300	533,200	1,820		124	.42	
		Aerial	760	103,000	35	15.0	136		.020
		Total	5,060	636,200	1,855	15.0	126		
	Kaniksu	Hand	640	59,000	330		92	.52	
		Aerial	1,150	259,000	38	30.3	225		.026
		Total	1,790	318,000	368	30.3	177		
	St. Joe	Hand	3,400	191,900	1,100		56	.32	
Within association, but outside of white pine management units	Clearwater	Aerial	370	60,100	20	5.0	162		.014
	St. Joe	Hand	1,370	33,300	270		24	.20	
White pine management units outside association	Clearwater	Hand	30	2,100	10		700	.33	
	Kaniksu	Hand	140	18,000	70		129	.50	
	St. Joe	Hand	360	15,900	100		44	.28	
		Aerial	1,180	88,800	10	20.0	75		.017
		Total	1,540	104,700	110	20.0	68		
Other areas of white pine outside association units	St. Joe	Hand	900	24,800	150		28	.17	
		Aerial	210	16,800	10	10.0	80		.048
		Total	1,110	41,600	160	10.0	37		
	All forests	Hand	11,140	878,200	3,850		79	.35	
		Aerial	3,670	527,700	113	80.3	144		.022
		Total	14,810	1,405,900	3,963	80.3	95		

STATE AND PRIVATE PROGRAM

5. Surveys - 1962

Forest	Type	Acres	Man-days	Helicopter hours
Clearwater	Antibiotic	51,260	56	6.0
Kaniksu	Antibiotic	17,800	10	7.9
St. Joe	Antibiotic Ribes	275,900 1,900	110 10	6.0
All forests		346,860	186	19.9

6. Total Effective Blister Rust Control Field Man-days - 1962

Forest	Ribes eradication	Antibiotic treatment	Surveys	Total
Clearwater	65	1,885	55	2,005
Kaniksu		438	10	448
St. Joe	10	1,640	110	1,760
All forests	75	3,963	175	4,214

7. Net Acres of White Pine by Age Classes - State and Private Ownership - 1962

Forest	Age classes by date of origin						Total acres
	1980-1961	1960-1941	1940-1921	1920-1881	1880-1841	1840 & Prior	
Clearwater	1,580	38,380	46,290	18,560	11,350	49,470	165,630
Coeur d'Alene		460	8,150	34,740	2,020	21,670	67,040
Colville				7,450			7,450
Kaniksu		960	31,090	89,230	11,880	12,070	145,230
Kootenai				630		630	1,260
St. Joe		5,700	28,800	40,500	5,200	81,400	161,600
All forests	1,580	45,500	114,330	191,110	30,450	165,240	548,210

STATE AND PRIVATE PROGRAM

8. Accumulative Summary of Antibiotic Treatment - State and Private Ownership - 1962

Forest	Ownership and state	Areas within white pine management units		Areas outside white pine management units		Total	
		Total acres	Acres treated to date	Total acres	Acres treated to date	Total acres	Acres treated to date
Clearwater	Idaho						
	State	16,840	3,530	33,050	510	49,890	4,040
	Private	54,000	7,010	61,740	300	115,740	7,310
	Total forest	70,840	10,540	94,790	810	165,630	11,350
Coeur d'Alene	Idaho						
	State	1,010	220	13,620		14,630	220
	Private	2,510		46,300		48,810	
	Total	3,520	220	59,920		63,440	220
	Montana						
	Private-all	3,600				3,600	
	Total						
	State	1,010		13,620		14,630	
	Private	6,110		46,300		52,410	
	Forest	7,120		59,920		67,040	
Colville	Washington						
	State	710				710	
	Private	880		5,860		6,740	
	Total forest	1,590		5,860		7,450	
Kaniksu	Idaho						
	State	25,280	4,060	20,260	2,840	45,540	6,900
	Private	12,710	50	40,270	30	52,980	80
	Total	37,990	4,110	60,530	2,870	98,520	6,980
	Montana						
	State	640		40		680	
	Private	1,960		5,540		7,500	
	Total	2,600		5,580		8,180	
	Washington						
	State	120		4,970		5,090	
	Private	2,180		31,260		33,440	
	Total	2,300		36,230		38,530	
	Total						
	State	26,040		25,270		51,310	
	Private	16,850		77,070		93,920	
	Forest	42,890		102,340		145,230	

8. Accumulative Summary of Antibiotic Treatment - State and Federal Ownership 1962 (Con.)

Forest	Ownership and state	Areas within white pine management units		Areas outside white pine management units		Total	
		Total acres	Acres treated to date	Total acres	Acres treated to date	Total acres	Acres treated to date
Kootenai	Montana						
	Private-all	1,260				1,260	
St. Joe	Idaho						
	State	18,200	10,530	34,600	2,180	52,800	12,710
	Private	29,300	3,940	79,500	950	108,800	4,890
	Total forest	47,500	14,470	114,100	3,130	161,600	17,600
Grand Total	Idaho						
	State	61,330	18,340	101,530	5,530	162,860	23,870
	Private	98,520	11,000	227,810	1,280	326,330	12,280
	Total	159,850	29,340	329,340	6,810	489,190	36,150
	Montana						
	State	640		40		680	
	Private	6,820		5,540		12,360	
	Total	7,460		5,580		13,040	
	Washington						
	State	830		4,970		5,800	
	Private	3,060		37,120		40,180	
	Total	3,890		42,090		45,980	
	All						
	State	62,800	18,340	106,540	5,530	169,340	23,870
	Private	108,400	11,000	270,470	1,280	378,870	12,280
	Total	171,200	29,340	377,010	6,810	548,210	36,150

NATIONAL PARKS PROGRAM

1. Expenditures, Calendar Year 1962

National Park	State	National Park funds	Forest Service funds - 720	Total all funds
Glacier	Montana	68,144	2,148	70,292
Grand Teton	Wyoming	258	200	458
Rocky Mountain	Colorado	10,191	499	10,690
Yellowstone	Wyoming	81,782	2,148	83,930
All parks		160,375	4,995	165,370

2. Field Organization - 1962

National Park	Camps	Employees ribes eradication	Employees antibiotic treatment	Total employees
Glacier	2		46	46
Rocky Mountain	1	8		8
Yellowstone	2	53		53
All parks	5	61	46	107

3. Total Progress Ribes Eradication - 1962

National Park	Acres	Man-days	Ribes	Per acre	
				Man-days	Ribes
Rocky Mountain	1,300	390	15,000	.30	15
Yellowstone	10,090	2,180	140,000	.22	14
All parks	11,390	2,570	155,000	.23	14

4. Antibiotic Treatment - 1962

National Park	Method	Acres treated	Man-days	Trees treated	Per acre	
					Man-days	Trees treated
Glacier	Hand	2,750	1,940	245,000	.71	89

NATIONAL PARKS PROGRAM

5. Surveys - 1962

National Park	Type	Acres	Man-days
Glacier	Antibiotic	4,140	80
Rocky Mountain	Ribes	1,490	40
Yellowstone	Ribes	25,390	340
All parks		31,020	460

6. Total Effective Blister Rust Control Field Man-days - 1962

National Park	Ribes eradication	Antibiotic treatment	Surveys	Total
Glacier		1,940	80	2,020
Rocky Mountain	390		40	430
Yellowstone	2,180		340	2,520
All parks	2,570	1,940	460	4,970

7. Chemical Eradication - 1962

National Park	Acres	Man-days	Ribes destroyed	Gallons of spray solution	Man-days per acre
Yellowstone	210	320	74,000	7,430	1.52

8. Control Status - Ribes Eradication and Antibiotic Treatment - 1962

National Park	Total acres	Unworked acres	Worked area		Acres treated to date with antibiotics
			Needing rework acres	On maintenance acres	
Glacier	17,000	10,990*	1,820	4,190	7,250
Grand Teton	1,010		100	910	
Rocky Mountain	12,650	4,050	390	8,210	
Yellowstone	69,020	31,160	7,410	30,450	
All parks	99,680	46,200	9,720	43,760	7,250

*These are acres added to program for antibiotic treatment only. There are no unworked acres in the original ribes eradication units.

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WHITE PINE BLISTER RUST CONTROL

Annual Report
Calendar Year 1963

U.S. DEPARTMENT OF AGRICULTURE
FOREST SERVICE
REGION ONE

MISSOULA, MONTANA

1380 (3000)

UNITED STATES DEPARTMENT OF AGRICULTURE

FOREST SERVICE

REGION 1

Missoula, Montana
March 1, 1964

WHITE PINE BLISTER RUST CONTROL ANNUAL REPORT

Calendar Year 1963

This report was prepared under the direction of E. H. Juntunen, Chief, Division of State and Private Forestry, by H. J. Hartman, Chief, Forest Pest Control Branch, and David A. Graham, Head, Blister Rust Control Section, from information furnished by and from the following:

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The following agencies are conducting or are actively cooperating in white pine blister rust control:

U.S. Forest Service
National Park Service
State of Idaho
Clearwater Timber Protective Association
Potlatch Timber Protective Association
Priest Lake Timber Protective Association
Bureau of Land Management
University of Idaho

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I. HIGHLIGHTS OF 1963 BLISTER RUST CONTROL PROGRAM

THE OVERALL BLISTER RUST CONTROL PROGRAM

General

A greater acreage of white pine was treated in 1963 for blister rust control than in any of the past 24 years.

Total National Forest and State and Private control program accomplishment on lands of all ownerships was 122,020 acres. In addition, the National Park control program accomplishment was 17,880 acres.

The National Forest and State and Private control program included some 11,350 acres of immature western white pine treated with antibiotics by the basal stem method, requiring 7,670 man-days or .68 man-days per acre. Phytoactin L-318 was applied as a foliar spray by helicopters on 100,600 acres of immature western white pine, requiring 1,888 flying hours. An additional 93 flying hours were used in making operational surveys. Blister rust control crews eradicated ribes on 10,070 acres, requiring 9,620 man-days or .96 man-days per acre.

The National Park program included 3,790 acres treated with antibiotics by the basal stem method, requiring 1,320 man-days or .35 man-days per acre, and ribes eradication on 14,090 acres, requiring 3,900 man-days or .28 man-days per acre.

At the present rate of progress, all of the 717,000 acres of immature western white pine on National Forest lands will have been treated with antibiotics in 1967. The 352,000 acres of immature western white pine on state and private lands will not be completely treated until 1979.

Integrated Control Methods

The following selective methods of white pine blister rust control are being practiced and developed:

1. Control by ribes eradication in selected stands under 10 years of age, or within areas specifically harvest-cut for western white pine regeneration.

2. Control by applying antifungal antibiotics to selected stands 10 to 100 years of age. The objective is to kill present rust infections and immunize for a period of time all treated white pine against future blister rust infections. Most of this application is done aerially with helicopters. Basal stem treatment is generally limited to stands 10 to 20 years of age, or stands otherwise not suited for aerial treatment.

3. Nursery stock immunization by applying antibiotics to all white pine seedlings in the nursery prior to outplanting.

4. Development and mass production of blister rust resistant western white pine planting stock through applied forest genetics.

Antibiotic Treatment Results

A large volume of canker evaluation data from treated areas was systematically collected during 1963. Evaluation procedures and canker examination techniques were improved. Sampling criteria and provisions for accurately measuring growth or lack of growth on treated cankers have been standardized and put into practice.

As a result of these innovations, reliable data covering a wide range of treatment conditions and stand variations over the entire western white pine range in the Region will be available in 1964.

The percentage of vigorous cankers inactivated by basal stem treatment with antibiotics on a project basis varies from 39 percent for the 1959 and earlier work, to 56 percent for the 1961 work. Most of the cankers evaluated are in the treatment zone since, for stands basal stem treated, this is where the majority of lethal infections occur. Some good results of canker inactivation through translocation of antibiotics are also found scattered throughout these project areas.

No project antibiotic aerial spraying was done prior to 1961. Evaluations of all 1961 aerial spraying show that 30 percent of the vigorous cankers have since become inactivated.

Comparative information taken from untreated areas on the same basis as for hand and aerial treatments show that 3 percent of the vigorous cankers have become inactive. The beneficial biological action in addition to complete canker inactivation found in the treated areas is lacking in these untreated areas.

Since evaluation of infections prior to the lapse of at least two growing seasons after treatment is not conclusive, no effectiveness information for the 1962 and 1963 work is available. Preliminary indications are that recent advancements made in antibiotic control methods have resulted in a corresponding increase in infection kill.

Immunization of Western White Pine Nursery Stock

In 1963, all white pine seedlings were treated with Phytoactin prior to outplanting in an attempt to immunize these trees against blister rust for a 5- to 10-year period. At this time no specific guarantee can be made regarding immediate or long-range benefits. Current test results appear promising. Several new tests were established in 1963.

Antibiotic Tests on Limber and Whitebark Pines

Effective antibiotic formulations and/or application techniques still have not been fully developed for killing blister rust infections on limber or whitebark pines. Absorption and translocation of antibiotics appear to be the main problems. Several new formulation test plots have been established. Both basal stem and ground foliar methods of application were tested.

By the year 2000, white pine blister rust will have destroyed most all unprotected limber and whitebark pine stands in this Region. These species have little commercial value, but by occupying an ecological niche unsuited to any other tree species, they have a significant affect on watershed and esthetic values.

Antibiotic Treatment of Mature Stands

While the 1961 aerial treatment tests in mature stands showed very heavy biological action in 1963, there was no positive evidence that the large infections on the tree boles were inactive. The biological action on most all blister rust infections resulted in very heavy top and branch flagging. Although this hastening of top and branch flagging appears alarming, it would have occurred a few years hence even though the stand had not been treated. Antibiotic treatment of mature western white pine stands cannot yet be recommended. Observation of results will continue in 1964, and additional test plots will be established.

Antibiotic Persistence

The exact period of white pine blister rust infection immunity that will result from a single application of an antibiotic is not known. New infection has not been detected in any areas properly treated with antibiotics in this Region. While it is now evident that antibiotics remain biologically active in properly treated trees for a period of years, the antibiotic persistence level required to prevent new blister rust pine infection is not known. Artificial inoculation and bioassay studies aimed at determining these answers are being conducted.

Spread of the Rust

Intensive scouting for new white pine blister rust infections outside of the known limits of the rust was not conducted in 1963. However, Intermountain Forest and Range Experiment Station personnel found white pine blister rust infection on limber pine in the extreme southeastern corner of Idaho on the Cache National Forest. This represents a 75-mile southern extension of known pine infection in that region. A greatly increased number of blister rust infected ribes were reported in the vicinity of Jackson, Wyoming, although no new pine infection was observed. All indications are that a heavy pine infection center will soon develop in Grand Teton National Park.

Blister rust infection on ribes in the western white pine belt was moderate to light throughout most of the type.

It is now evident that 1959 was a moderately heavy pine infection wave-year. Light to moderate pine infection of 1959 origin was observed this year in many unprotected stands. One contributing factor was the heavy September 1959 precipitation, which amounted to 9.21 inches at Headquarters, Idaho, and 7.79 inches at Elk River, Idaho. Normal September precipitation for these locations is 2.54 and 1.72 inches respectively.

Antibiotic Side Effects

No harmful side effects have been associated with the treating of 330,000 acres with antibiotics. No detectable damage has occurred to fish, wildlife, beneficial insects or fungi.

Antibiotic Research and Development Expansion

During 1963, eight scientists worked nearly full-time on basic and applied antibiotic research and developmental work. Three were stationed at the new Forest Sciences Laboratory at Moscow, Idaho; two were employed under a Phytoactin fellowship at Washington State University; and three were members of the Methods Development and Improvement Branch at Spokane, Washington.

Economic Study

Much progress has been made in data collection for the new western white pine production and management economic study. Three full-time men and several part-time men from research and administration have worked throughout the year on this study. It is scheduled for completion in 1965.

Antibiotic Formulation and Application Improvements

The following procedures were initiated in 1963 in order to increase spray solution absorption and/or translocation in treated pines:

1. Water softeners were installed on four of the six antibiotic mixing-service units used. These water softeners were used this fall to reduce the hardness of the water used in aerial spray formulations on some Forests.

2. The hydrogen-ion concentration of all water used in formulating aerial spray solutions in 1963 was reduced to a range between pH 4 and pH 5 by adding prescribed amounts of crystalline sodium bisulfate.

3. A low aniline point oil was tested in both basal stem and aerial spray formulations. The aniline point for most western No. 1 fuel oils ranges between 140° and 150° F. The light cycle oil used had an aniline point of 96° F.

4. The cankers on all trees retreated by the basal stem method were scarified (adjacent bark punctured) as part of the treatment. Scarification was also employed with the basal stem method on several initially treated areas.

CLEARWATER NATIONAL FOREST AND CLEARWATER TIMBER PROTECTIVE ASSOCIATION

White pine blister rust control on National Forest lands was accomplished mainly by ribes eradication and antibiotic aerial treatment. Ribes eradication was confined to those areas that had been recently prepared for white pine regeneration. Some immature state and private white pine stands that could not be aerially sprayed were treated with antibiotics by hand.

Seven base camps were established in 1963 within the Independence, Sheep Mountain, Orofino Creek, Musselshell, Alder Creek, Deer Creek and Hildebrand Creek white pine management units.

Five spike camps were established for crews engaged in aerial application of antibiotics. Aerial treatment with antibiotics was continued in white pine pole stands on state, private, and Federal land within the Hildebrand, French, Orofino, Rosebud, Washington, Musselshell, Cedar, Chamook, Lolo-Nevada, Gold, Dollar, and Siberia Creek white pine management units.

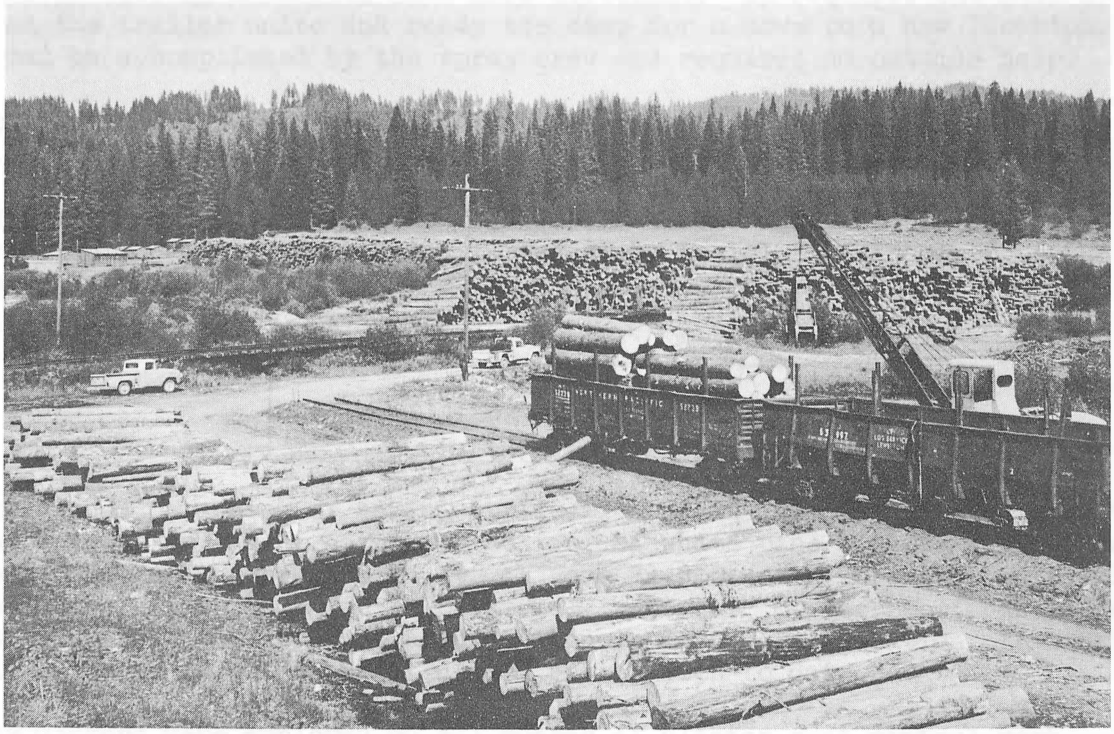
Not all the 1963 objectives were attained, as weather conditions and a late season fire reduced available fall spraying time. Plans called for aerial application of antibiotics to 9,000 acres in the fall program, but only approximately 4,000 acres were treated. Unusually high temperatures, accompanied by light winds in September greatly reduced effective spray periods. The first full week of October was lost when both helicopters and the service crew were called for fire duty.

Nearly 15 percent of the total man-days available for project work was spent on firefighting assignments this season. This is considerably more time lost to fires than the previous year but does not compare with the 1961 season when 40 percent was lost to firefighting activities.

Field work of the five camps established on National Forest lands concentrated on ribes eradication with power spray equipment in controlled-burn areas within the Alder, China, Orofino, and Musselshell Creek units. Hand ribes eradication was also continued in these units and was completed in the protection zones for the Sheep Mountain and Laundry Creek units. Extended ribes seed germination in the Sheep Mountain unit will necessitate some rework to prevent infection of the new crop of white pine.

The two camps established on state and private lands were engaged in hand application of antibiotics to young white pine in the Hildebrand, Deer, and Reeds Creek units. This is a continuation of the plan to hand treat all reproduction within approved management units that cannot be treated aerially because of overstory. At the present rate of financing it will require two more seasons to complete this initial treatment.

Basal stem treatment, Clearwater National Forest.



Log landing near Pierce in center of western white pine production area, Clearwater National Forest.

The completion of the Kamiah Ranger Station at Kamiah and subsequent move of the Pierce Ranger District headquarters to Kamiah enabled the blister rust project to acquire much needed office and vehicle storage space at the Pierce administrative site. This is the first time since the inception of the BRC program that all project equipment and supplies have been stored in one location.

Dr. James W. Kimmey of Forest Sciences Laboratory at Moscow, Idaho, installed two antibiotic experimental plots on private lands within management units this season. One series of plots will test hand antibiotics application and one will test aerial antibiotics application. Some 114 man-days of time were contributed in assisting in such things as boundary marking, tree marking, and tree treatment on these plots. The aerial spray plots were selected, marked and made ready for spraying but were not sprayed because of weather conditions. These aerial plots will be treated in the spring of 1964.

Survey work was completed on approximately 62,000 acres in 1963. Included in this acreage are ribes population checks, antibiotic effectiveness evaluations and surveys of stands to determine antibiotic treatment potential.

An additional 300 acres within white pine management areas were control-burned and prepared for planting. Because of good burning conditions this site preparation was very satisfactory.

Two trailer houses were constructed during the spring for use by the aerial spray crew. This kitchen and bunkhouse unit proved to be very timesaving and made moves between helispots much more efficient. It requires one-half hour to load the trailer units and ready the camp for a move to a new location. This can be accomplished by the spray crew and requires no outside help.

The project had a total of 12 reportable accidents of which four were lost time.

Staff Assistant Ted E. Leach was transferred to the Kelly Creek Ranger District in June and was replaced in August by Daniel K. Chisholm from the Nezperce National Forest.

COEUR D'ALENE NATIONAL FOREST

The continued expansion of aerial application of antibiotics in 1963 resulted in the largest acreage treated for control of white pine blister rust since the beginning of the program in 1927. Some 31,380 acres were treated by all methods, including 28,820 acres of aerial treatment, 800 acres of basal stem treatment, and 1,760 acres of hand and chemical ribes eradication. A total of 61,720 acres have been treated with antibiotics to date.

Eighty workers were employed on all phases of blister rust control work. Crews were stationed at the Hudlow Work Center, Trail Work Center, Shoshone Work Center, and Potter Creek Blister Rust Control Camp. Hand and chemical ribes eradication was performed on prescribed-burn areas in the Hudlow, Potter, and Yellow Dog white pine management units. Antibiotics were applied by basal stem method to selected small areas of reproduction and pole white pine not suitable for aerial treatment in the Hudlow and Burnt Cabin units.

Snow removal from roads and heliports was started on April 8 in preparation for spring aerial spraying. Two helicopters started spraying on April 25 and two additional helicopters were transferred from the Kaniksu Forest on May 22. The spraying of 17,720 acres was completed on June 21. Weather conditions were extremely unfavorable for spraying from April 25 to May 10. No spraying was accomplished on 7 of the 14 days which resulted in an average of only 1.4 spray hours per day for the period. From May 11 to June 21 the daily hours of spraying averaged 3.1.

Fall spraying operations started with two helicopters on September 3 and two additional helicopters were transferred from the Kaniksu Forest on September 17. Spraying was completed on October 4. A total of 11,100 acres were treated. Unusually warm temperatures prevailed during September reducing the average daily flight time to 2.2 hours per day compared to 3.6 in the fall of 1961 and 2.9 in the fall of 1962. A total of 564 hours were flown by all helicopters on aerial spray operations and 18.5 hours on aerial surveys during the season. Six heliports were constructed for use during the fall of 1963 and the spring of 1964.

As more white pine areas are treated with antibiotics the sampling for effectiveness determinations becomes a more complex and time-consuming job. A 6-man crew, under the direction of the project survey assistant, spent the major part of the season on this activity. Permanent sample line plots were established in all major blocks treated during 1963. Line plots established in past years were maintained and examinations of all previously marked infections were made where sufficient time had elapsed since treatment to give reliable results. Twenty-nine new line plots were located in blocks sprayed in 1963. These line plots averaged 25 trees per strip and 1.3 cankers per tree. Many improvements were made in evaluation procedures and canker examination techniques during the year.

Although 407 acres were planned, due to dry fall weather, only 28 acres of white pine were planted in the Potter Creek prescribed-burn areas. Seven acres were planted to white pine in the Flora Miller Hill area and 66 acres in the Beetle Creek burn for a total of 101 acres of white pine planted during the calendar year. Approximately 500 acres were prescribed burned in white pine management units on white pine sites. Poor burning conditions during the late fall resulted in unsatisfactory burns from a blister rust control and planting standpoint.

Weather conditions were very favorable for control activities, other than aerial spraying. Lost time from project work for fire suppression was below average. A total of 600 man-days were spent on fire suppression activities with only 330 effective man-days lost from project work. This amounts to approximately 7 percent of possible effective man-days for the season as compared to the 15 percent average for the past 5 years, 1959 to 1963.

An effective safety program plus a high percent of returning experienced overhead and workers resulted in one of the best safety records in the history of the project. There were no lost-time or vehicle accidents, and only one minor reportable accident was charged to the project.

KANIKSU AND COLVILLE NATIONAL FORESTS AND PRIEST LAKE TIMBER PROTECTIVE ASSOCIATION

Control of white pine blister rust on the Kaniksu and Colville National Forests and the Priest Lake Timber Protective Association during 1963 was accomplished mainly by basal stem or aerial application of antibiotics. Since use of antibiotics began in 1956, a total of 71,330 acres of high-value, immature white pine have been treated.

Total number of men employed in the organization remained about the same as in 1962. During the peak of the season 100 men were employed. A 10-man ribes eradication camp was located in the Goose Creek drainage on the Falls District. Four crews, including one working from the main headquarters at Kalispel Bay and a local crew commuting from the town of Priest River, were used for basal stem application of antibiotics. A 30-man camp was located on Upper Lamb Creek on the Priest Lake District, and on the Colville National Forest a 10-man crew hand treated a 540-acre western white pine plantation at Tiger Hill.

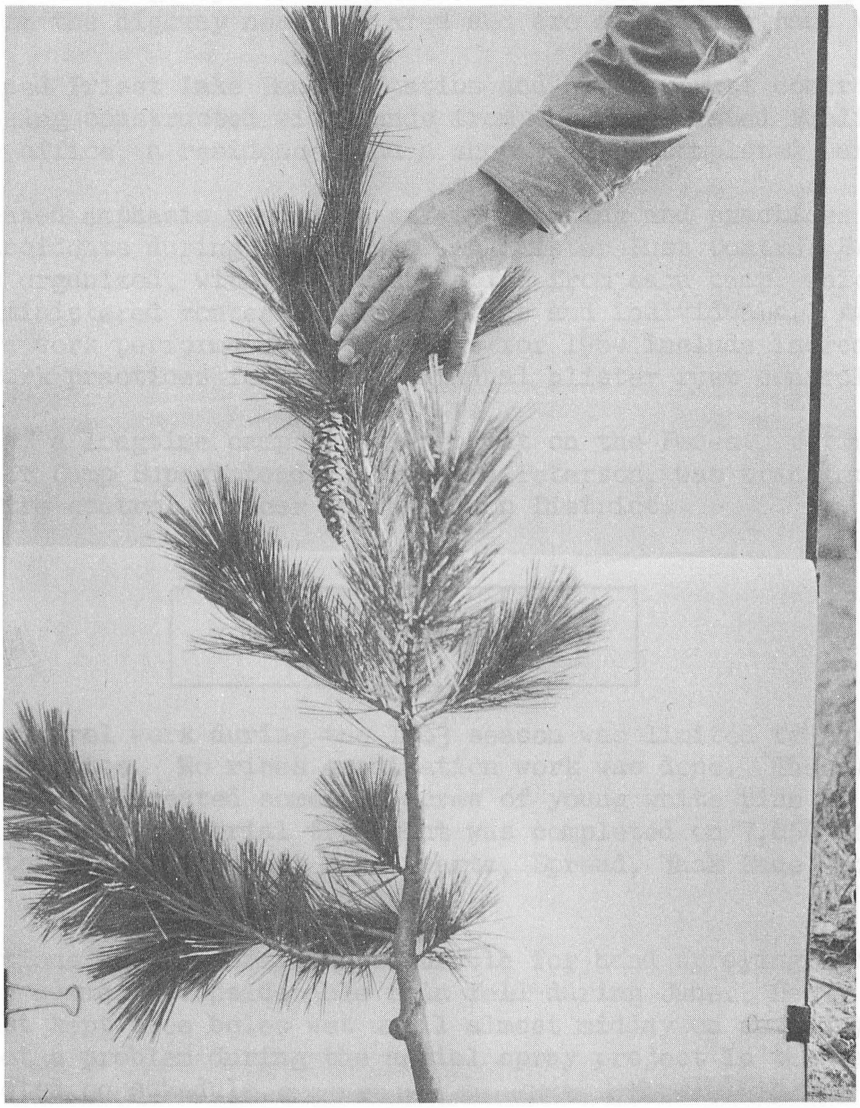
Aerial application of Phytoactin was accomplished on 26,860 acres in 1963. This is the largest single year total sprayed to date on this Forest. Two units, with two helicopters each, sprayed white pine areas on the Priest Lake and Falls Districts during April, May, and June. Fall spraying was done on the Trout Creek and Falls Districts during September and early October. All planned acreage was sprayed.

Twelve of the most experienced men were used during the summer on surveys. The surveys included efficiency and status checking of ribes eradication areas, evaluation of antibiotics effectiveness, and intensive and extensive blister rust damage surveys. On the Newport District a helicopter was used to inspect and determine white pine aerial spray boundaries on 40,000 acres. Fourteen thousand acres were also inspected and mapped on the Priest Lake Timber Protective Association.

A crew worked from early June through the early part of December on helispot construction. Twenty-five new helispots were constructed; 19 on the Kaniksu Forest, 3 on the Colville Forest, and 3 on the Association. Since 1960, a total of 46 helispots have been constructed for aerial spray work. All ground disturbed at helispot sites has been seeded to grass and fertilized.

Very little project worktime was lost to fire suppression activities during the year. One 60-man crew was dispatched to the Little Granite Creek fire on the Nezperce National Forest and several small crews were used to fight fire on the local districts.

Rain and heavy dew continued to cause lost production for the antibiotic hand treatment crews. Brief rainstorms occurred often during the months of July and August causing considerable lost worktime. Early morning dew caused some problems and made it necessary to reschedule the workdays during the month of August.



Cone on young tree in the rust resistant white pine seed orchard at Sandpoint. Scionwood, obtained from a cone producing age tree, was grafted to stock outplant in 1960. Trees similar to the one pictured above are expected to produce one to three cones next year, Kaniksu National Forest.

The rust resistant white pine seed orchard at Sandpoint, established in 1960, is producing cones. The first viable seed was collected this year. Examination of the orchard shows that many of the young trees will produce cones in 1964.

Noxious weeds and hardwood saplings in and around the seed orchard were destroyed and a drainage system installed. The trees are now large enough to be visible from the highway near the area and are attracting many visitors.

The new combined Priest Lake Ranger Station and blister rust control headquarters is being constructed with funds from the Accelerated Public Works Program. The office, a residence, and a shop will be completed early in 1964.

Despite increased emphasis placed on safety training and practices the project had several accidents during the season. A Blister Rust Control Safety Committee was organized, with a representative from each camp, which established and administered contests between crews and individuals. Awards were given for safe work performance. Our plans for 1964 include increased emphasis on safe work practices for each individual blister rust control employee.

Leonard Easley, a longtime camp superintendent on the Forest, retired in March. Another Camp Superintendent, Richard Peterson, was transferred and promoted to fire control officer on the Noxon District.

KOOTENAI NATIONAL FOREST

Blister rust control work during the 1963 season was limited to the application of antibiotics. No ribes eradication work was done. The 14 workers employed, basal-stem treated some 400 acres of young white pine in the South Fork Callahan drainage. Aerial treatment was completed on 7,650 acres of pole-size white pine in the West Fork Quartz, Spread, Yaak Face, and Burnt Creek units.

Weather conditions were generally unfavorable for hand spraying during a large portion of the summer. Considerable rain fell during June. Heavy dew during July and August kept tree boles wet until almost midday on some days. Weather was not a problem during the aerial spray project in the fall and the job was completed on schedule.

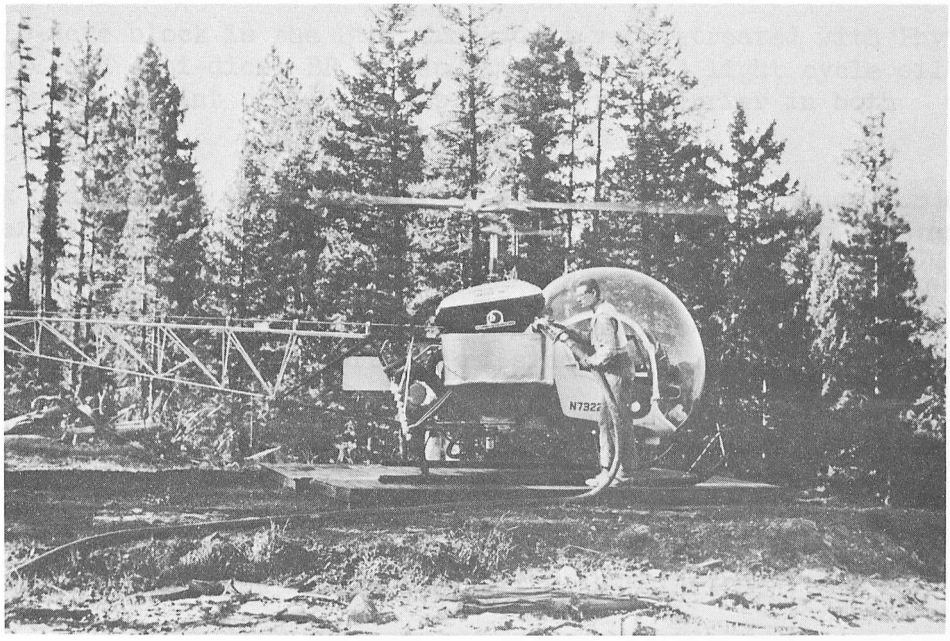
A total of 120 man-days were spent on fires. Of this total, 90 were effective man-days that would have been available for field work. A total of 159 effective man-days were lost because of wet weather conditions. Time lost to fire and weather represents 31 percent of the total time that would otherwise have been available for basal stem treatment.

Several basal stem test plots were established during the summer as follows:

1. Acti-dione BR current formulation with scarification.

2. Phytoactin L-440 with scarification, boles wet.

3. Phytoactin L-440 with scarification, boles dry.



Crewman loading G-3B helicopter with antibiotic solution (Phytoactin), Quartz Creek heliport, Kootenai National Forest.

G-3B1 and G-3B helicopters arriving at the Quartz Creek heliport to reload with antibiotic (Phytoactin), Kootenai National Forest.

4. Phytoactin L-440 without scarification, boles wet.

5. Phytoactin L-440 without scarification, boles dry.

6. A 10-acre block in the Star Creek unit was retreated with Phytoactin L-440 and Acti-dione BR in separate tests. A light cycle oil with an aniline point of 96° F. was used as the carrier in both formulations.

Survey work was limited to establishing permanently marked trees for evaluating the effectiveness of antibiotics in areas treated during 1963 and evaluating treatment results of prior years.

The operation completed another season without a lost-time accident. This makes a total of 235,168 man-hours worked since the last lost-time accident on July 5, 1951.

ST. JOE NATIONAL FOREST AND POTLATCH TIMBER PROTECTIVE ASSOCIATION

There were 120 workers employed on blister rust control during 1963. Eighty employees were stationed in field camps located at West Fork Charlie Creek, Clarkia Ranger Station, and Feather Creek. These workers hand treated immature white pine with the antibiotic Acti-dione on 4,200 acres of Federal, 1,030 acres of state, and 460 acres of private land.

One 40-man state and private camp was stationed on the East Fork Potlatch Creek near the mouth of Bobs Creek. This unit eradicated ribes from 1,900 acres in the East Fork Potlatch drainage near Badger Meadows. The removal of ribes from this recently cutover land, where white pine regeneration is planned, is necessary to protect white pine seedlings from blister rust until the trees are large enough for effective antibiotic treatment.

The initial hand spraying of most immature white pine stands, suitable for basal stem antibiotic treatment, was completed within the St. Joe approved National Forest and state and private white pine management units during 1963.

Future basal stem antibiotic spraying will be mostly limited to the retreatment of immature white pine stands where initial hand spraying was not satisfactory. All live cankers will be scarified when retreated. Scarifying the canker margin will allow better penetration of the antibiotic and improve treatment effectiveness. Some recently established white pine stands will need to be initially treated with antibiotics as soon as they become large enough for effective treatment.

Helicopters sprayed the antibiotic Phytoactin on 24,450 acres of Federal, 1,880 acres of state, and 450 acres of private white pine pole stands during 1963. White pine stands were treated during April through June in the North Fork Palouse, South Fork Palouse, Big Sand, Little Sand, and Strychnine units

by two helicopters stationed at the mouth of White Pine Gulch on the North Fork Palouse River. Two helicopters located at Clarkia treated white pine in the Cedar-Blair, West Fork Merry Creek, Clarkia, Keeler, Anthony, and Flewsie-Gramp Creek units during May. The remaining untreated white pine pole stands in the North Fork St. Joe River and the Loop Creek drainage were aerially sprayed in September with two helicopters.

The St. Joe blister rust control project supervised and conducted the aerial application of Phytoactin to 160 acres of white pine pole near the mouth of Merry Creek, owned by Potlatch Forests, Inc. A helicopter based at Clarkia, Idaho, sprayed the area during May 1963. Fifty percent of the cost of treating this private land was paid by Potlatch Forests, Inc., under a special cooperative agreement. Federal funds were used to match the private contribution, as authorized by the Lea Act of April 26, 1940.

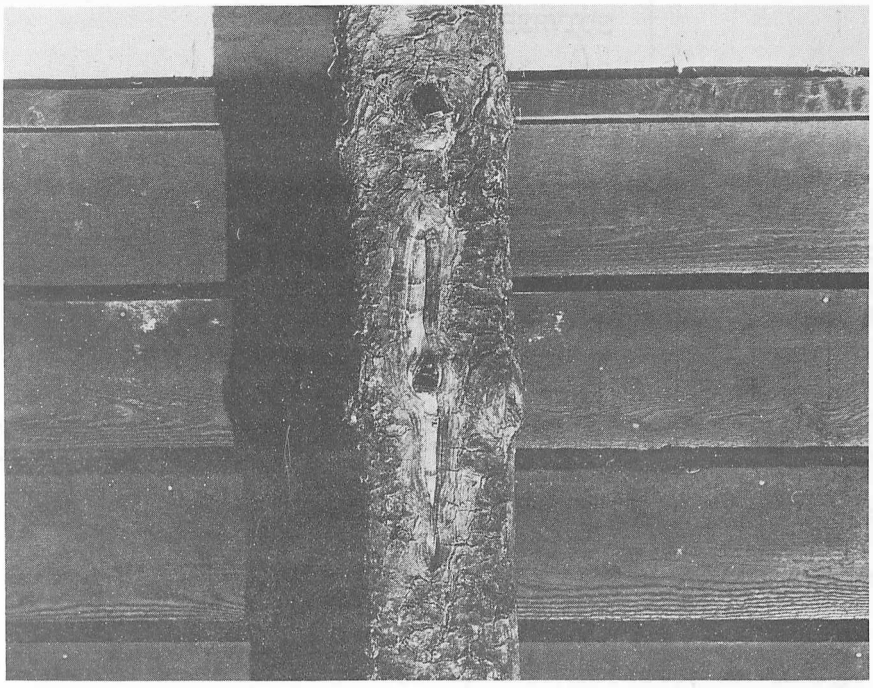
Weather conditions favored blister rust control field activities again this season. The summer was generally cool and dry. Although the St. Joe Forest controlled a record number of fires this season (259), only 450 effective control man-days were lost to fire suppression work. The blister rust control organization spent a total of 890 man-days on fire suppression work, standby, and training, including overtime and weekend work.

Antibiotic treatment evaluation crews have systematically established 2,116 study trees in both basal stem and aerially treated white pine stands. The study trees have been well marked and all stem cankers on sample trees have been marked, measured, and recorded to provide for effective future evaluations. Household pins have been used to mark the canker margins. Pins will be placed on canker margins during subsequent inspections to show canker growth, or lack of growth.

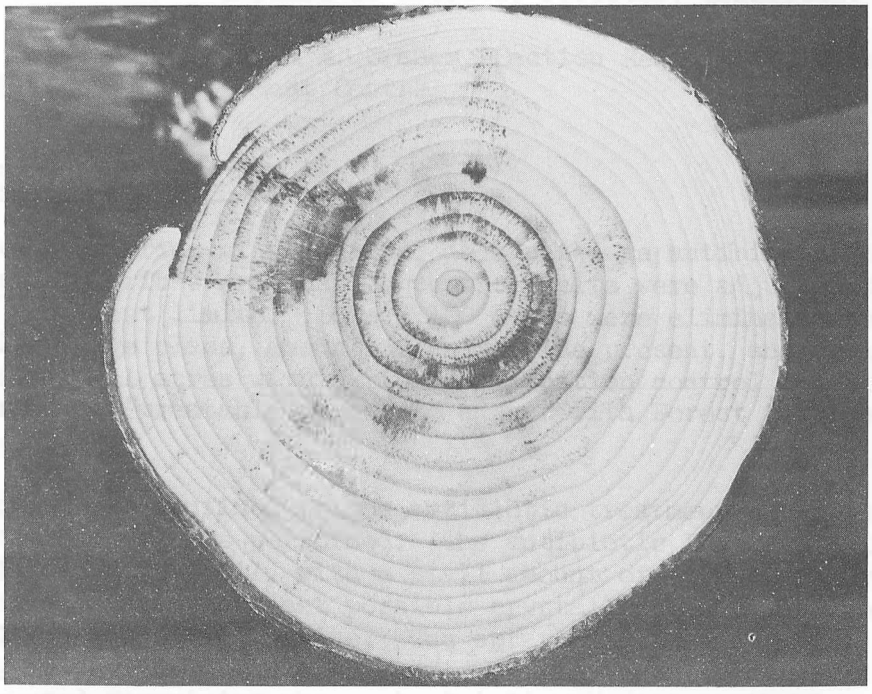
The blister rust control organization has been coordinating white pine antibiotic treatment work with timber stand improvement projects. Foresters marked the "leave" white pine stems on several hundred acres of plantation in the Charlie Creek drainage during the fall and winter of 1962-1963. Blister rust control crewmen treated the "leave" trees with antibiotics during the summer of 1963. The thinning work was done after crews had finished treating the marked stems. The marking-treating-thinning sequence on white pine thinning projects is preferred, as only crop trees are treated and treating crews can move through the stand without being hindered by thinning slash.

The planned blister rust control program for 1964 includes a 30-man ribes eradication camp in the East Fork Potlatch Creek drainage to continue control work in newly established white pine stands where the mature overstory has been recently removed. Aerial antibiotic treatment is planned in the white pine pole stands on the Palouse River near Laird Park, Jerome-Big Creek, West Fork Potlatch, Moose Creek, and Corral Creek areas during the spring and fall of 1964.

The St. Joe blister rust control safety program was again very effective in 1963. The project had only one medical case which resulted in 4.5 lost workdays because of an employee's allergy to the basal stem antibiotic solution. Good first aid treatment by the camp superintendents effectively prevented infection in cuts, lacerations, abrasions, and blisters, and kept minor injuries from becoming medical cases.



Blister rust canker on a 4" d.b.h. white pine tree showing how healing progresses 5 years after treatment with Acti-dione, St. Joe National Forest.



Transverse section view through above canker showing growth rings and healing of canker area after infection was killed by Acti-dione treatment in 1958. Tree was cut in late August 1963, St. Joe National Forest.

NATIONAL PARK SERVICE

MIDWEST REGION

The 1963 white pine blister rust control program was conducted as provided by the Lea Act and the 1961 agreement between the U.S. Departments of Interior and Agriculture. The National Park Service assumed complete responsibility for operational activities and coordination between Parks. The Forest Service furnished interagency leadership and gave assistance in accord with the agreement between the two agencies.

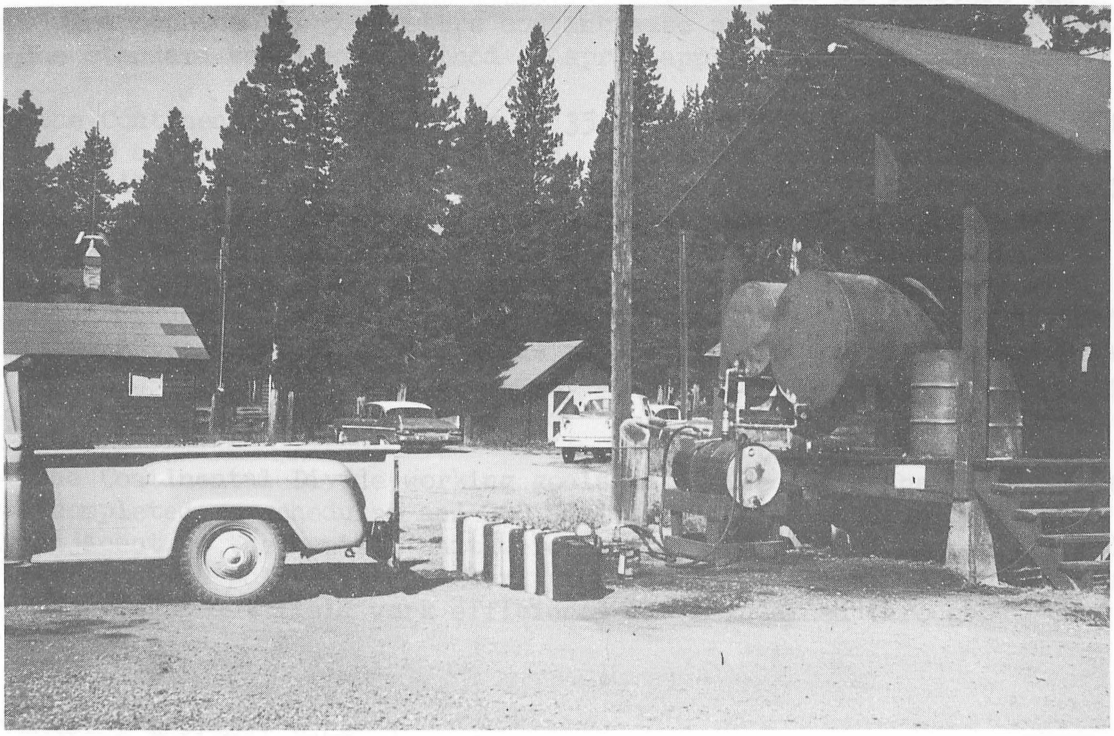
Personnel Participating

Glacier	C. Donald Barnum, Supervisory Park Ranger in Charge (until May 1, 1963) Charles A. Budge, Supervisory Park Ranger in Charge (after May 1, 1963)
Yellowstone	Marion W. Myers, Park Forester in Charge John N. Reeves, Forestry Technician, Project Supervisor
Rocky Mountain	Robert K. Weldon, Park Forester in Charge
Regional Program	John C. Gynn, Forester (TM) in Charge Maynard B. Barrows, Forester, Consultant
U.S. Forest Service, Northern Region	David A. Graham, Section Head, White Pine Blister Rust Control

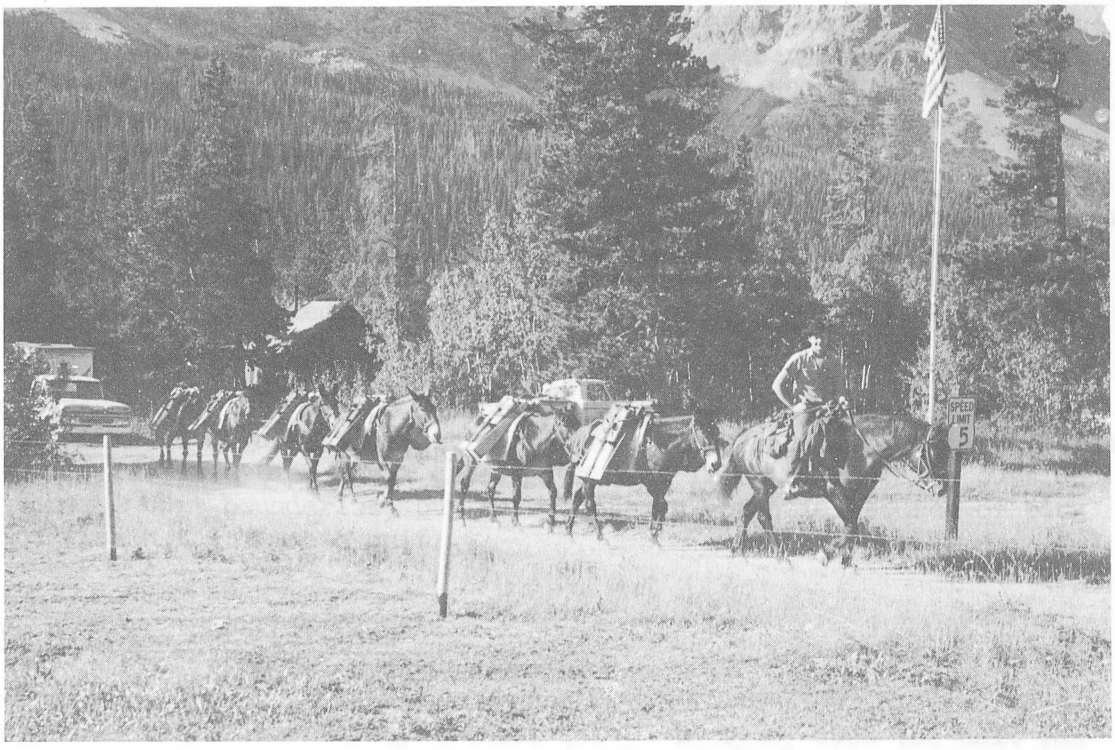
Glacier National Park

The tentative boundaries of all areas, designated as antibiotic "treatable acres," outside of ribes eradication control units were adjusted to conform with actual treatment limits. Some 3,100 acres were eliminated because of inaccessibility, age class, amount of white pine present, and/or advancement of the disease. All acres within ribes eradication control units have now been classified as "treatable acres" to adjust with Forest Service reporting procedures.

The 1963 program was confined to the antibiotic treatment of white pine. No ribes eradication work was performed. The antibiotic Phytoactin L-440 at 200 p.p.m. in No. 1 fuel oil, with a small amount of surfactant Triton B-1956 added as a safety factor against possible crystallization, was used for treating all species of white pine. The spray solution was mixed with an electrically-driven ECO circulating pump. A light portable gasoline-driven ECO pump was used for mixing where electricity was not available. Beginning about July 22 a new type scarifier spray nozzle developed by the Branch of Methods Development and Improvement, Forest Service, became available and was



Antibiotic mixing plant at the East Glacier Ranger Station, Glacier National Park.



Mule string packing antibiotic spray solution from Two Medicine Ranger Station to Oldman Lake, Glacier National Park.

used on all units. Purpose of the scarifier addition was to puncture the smooth bark around canker perimeters and increase penetration of the antibiotic. The standard basal stem method of spray application was used.

West of the Continental Divide a crew of 35 men treated 164,000 western white pine on 2,310 acres. The North Fork Road, West Shore of Lake McDonald, Avalanche Trail, and Mineral Creek units were completed. Finishing the Coal Creek area in 1964 will complete all western white pine areas approved for treatment to date. A small amount of retreatment may be necessary where treatment was performed prior to improved formulations, methods, and/or spraying techniques. Inspections show that effectiveness has increased each year following treatment, i.e., in areas treated in 1960 canker mortality was continuing in 1963. As in 1962, inclement weather interfered with work progress to a considerable degree.

East of the Continental Divide working goals were exceeded. The Oldman Lake unit was completed as scheduled and 200 additional acres outside, but immediately adjacent to the control unit were treated. A crew of 11 men treated 198,000 sapling- to pole-size whitebark pines on 1,480 acres. A high standard of camp management and field work efficiency was maintained throughout the summer.

Yellowstone National Park

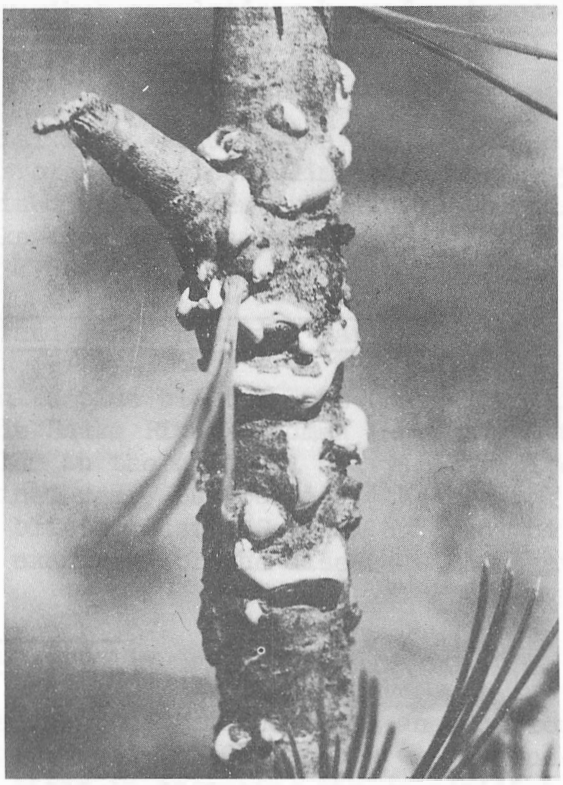
To cope with the transition from eradicating large ribes concentrations on steep mountain slopes and swampy stream type strips, to eradicating lightly scattered ribes and small widely dispersed concentrations, the field organization was changed. The use of large crews was eliminated. After intensive training, men were carefully selected as to their aptitude in the various ribes eradication methods, efficiency and working speed, and then organized into small highly mobile crews. Checkers and foremen were trained to expedite progress of the work by demanding a high standard of efficiency and coordinating the various methods of ribes eradication.

All 1963 objectives were achieved or excelled. Initial ribes eradication was performed on 10,160 acres. An additional 2,180 acres were reworked and 690 acres maintained as scheduled. A control status examination resulted in 8,630 acres in the unworked and rework categories being placed on a maintenance basis.

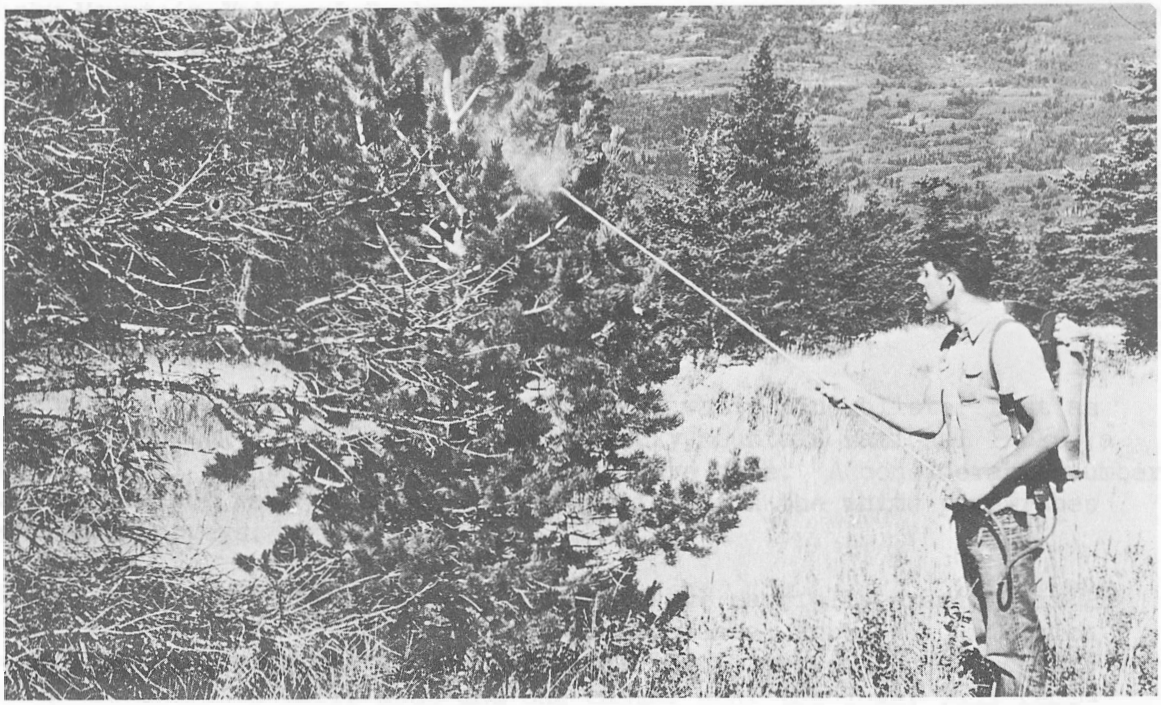
To give added protection to the Mammoth limber pine unit, heavy masses of Ribes petiolare (a highly susceptible species) were eradicated from 40 acres in the badly infected Glen Creek area. The area freed of ribes is outside of the control unit boundaries, but represented a potential source of pine infection within the Mammoth unit.

Rocky Mountain National Park

Approval of the revised regional program permitted starting initial ribes eradication in the Hidden Valley control unit. In 1956, when the unit was first surveyed and a ribes eradication working plan prepared, it was recognized that the heavy masses of ribes in the stream type, blowdown, and ski



Blister rust canker on a small limber pine fruiting for the second time in 1962. This tree was dead in 1963, Yellowstone National Park.



Hi-Fog sprayer with long mist nozzle used in foliar spraying trees in the Hudson Bay Divide study plots. This mist maker develops 1,000 p.s.i. at the nozzle.

runs made the central portion of Hidden Valley the most favorable for inception of the disease. Work schedules were planned accordingly. Since 1956, heavy ribes populations have developed in newly disturbed areas. This occurrence has increased the number of acres originally designated for chemical ribes eradication.

Initial ribes eradication was performed on 1,060 acres. Included were 140 acres of heavy ribes eliminated by the power spray method from under and entwined with fallen trees in the blowdown, and logs left along trails and creeks from ski trail clearings.

Grand Teton National Park

No white pine blister rust control work was performed in 1963. Inspections of the Snake River-Deadman Bar control unit, indicate that the ribes seedling problem in the original heavy ribes sites is diminishing. A number of ribes examined near, but outside, the control unit boundaries, were badly infected with blister rust. Several hundred white pines in the vicinity of Jenny Lake were examined for the disease with negative results.

Surveys

In Yellowstone National Park an additional 56,390 acres in the Grebe Lake area were surveyed in 1963. This white pine-ribes distribution survey will be used as a basis in assessing the possibility of extending the white pine blister rust control program in the Park.

In Rocky Mountain National Park a preliminary survey was made on 390 acres in preparation for extending the Hidden Valley tentative control unit boundary to natural barriers east of the Many Parks Curve overlook.

In Glacier National Park a preliminary stocking-disease survey was made on 1,230 acres of western white pine type near the old Flathead River Ranger Station. These data will not be analyzed until additional information is obtained in 1964.

Scouting

To determine the spread and intensification of white pine blister rust as pertinent to Yellowstone, Grand Teton and Rocky Mountain National Parks, a number of casual and systematic inspections were made. A considerable number of trees and ribes were examined in conjunction with the white pine-ribes distribution surveys.

A total of 6,720 white pines and 8,600 ribes were carefully examined in 26 drainages in the Parks and on three adjacent National Forests. Infection was found on white pine in two new locations in Yellowstone. Two cankers were found in the Obsidian Cliff area and one canker near the Tower Fall campground. Intensification of the disease is continuing at a rapid rate outside but in the vicinity of the Mammoth limber pine control unit.

No new ribes or white pine infection centers were found in or adjacent to Grand Teton or Rocky Mountain National Parks. However, an unusually large number of infected ribes were noted in previously known ribes infection centers in Grand Teton and vicinity.

Summary

The National Park Service Midwest Region's white pine blister rust control program is being performed in accord with the long-range plan. All work schedules are predetermined and based on pathological and other factors related to control and/or prevention of rust introduction. All work scheduled through 1963 has been completed as planned.

The revised long-range estimate and future work schedules allow for immediate use of the aerial antibiotic foliar spray method on the heavily infected stands of whitebark and limber pine in Glacier, when an effective foliar spray formulation is found. The long-range estimate also reflects the possible inclusion of some additional highly valuable stands of seedling-to pole-size whitebark pine in Yellowstone, if determined desirable.

The disease is rapidly intensifying and spreading southward from known infection centers in Yellowstone. It has been found on pine and in increasing abundance on ribes in Grand Teton. However, only one canker has ever been found in all of the control units in Yellowstone, Grand Teton, and Rocky Mountain. The single pine infection was of 1945 origin, and had occurred before ribes eradication had been initiated in the area.

Performing ribes eradication before infection occurs, and continued timely maintenance of the control areas, are the important factors contributing to successful prevention of establishment and/or control of the rust in the white pine units of Yellowstone, Grand Teton, and Rocky Mountain National Parks.

II. ANTIBIOTIC DEVELOPMENT AND IMPROVEMENT WORK IN WHITE PINE BLISTER RUST CONTROL - 1963

The Methods Development and Improvement Branch for forest disease control is located in Spokane, Washington, and is composed of the following personnel:

Virgil D. Moss, Pathologist
Wayne E. Bousfield, Forester
Donald H. Brown, Pathologist
John F. Breakey, Equipment Specialist
Elizabeth S. Guillot, Clerk
Lola D. Becker, Laboratory Technician

Progress in the development and improvement of blister rust control methods for the calendar year 1963 has included: (1) tree infection examinations to evaluate test results in aerial and hand applied spray solutions, (2) new plot establishment in aerial and hand spraying, (3) program expansions of antibiotic tests on whitebark and limber pines in Glacier National Park, (4) artificial inoculation of western white pine in the nursery and field to determine antibiotic treatment protection periods against new blister rust infections, (5) collection of foliage and bark samples from treated trees to quantitatively measure by bioautographic and chromatographic laboratory procedures the absorption, translocation, and persistence of antibiotics, and (6) laboratory testing of antibiotic concentrates, spray solutions, oils, and water used in the preparation of aerial and basal stem spray solutions.

A. Nursery and Reproduction Studies

The protection of western white pine plantations and natural reproduction from blister rust infections is an intricate phase of the blister rust control program. Small white pines are vulnerable to blister rust infections when grown in close association with ribes and when microclimate conditions are favorable.

The purpose of protective nursery and reproduction studies is to develop methods of antibiotic application that will maintain adequate antifungal antibiotic material in the needles and prevent sporidial germ tube development following needle penetration.

Application methods tested to date are aqueous soil drench, root slurry, foliar spray, foliar dip, complete dip, soil tablet, root aqueous absorption, and soil treatment with powder forms of antibiotics.

1. Seedling studies.

a. Status of 1961 nursery tests.

A statistically designed study was started in May 1961 to test Phytoactin aqueous foliar sprays as a protectant against white pine blister rust infections (fig. 1). Phytoactin 100, 200, and 300 p.p.m. with and without Triton X-155, 0.1 percent was applied as an aqueous foliar spray to 2-1 western white pine seedlings. Four spray schedules were made to compare differences of seasonal applications and effect of double and triple applications. No additional antibiotic treatment has been made since

Figure 1.--Phytoactin foliar spray study, 1961. Stakes among trees represent infected seedlings.

September 1961. All trees were artificially inoculated in September 1961 and again in September 1962 (table 1).

Table 1.--Results after 1961 and 1962 artificial inoculation of western white pine seedlings treated with Phytoactin foliar sprays in 1961

Spray schedule	Phytoactin concentration (p.p.m.)	Percent seedlings infected after two inoculations		
		Without Triton	With Triton	Average
June	0	87	80	84
June, September		84	42	63
June, July, September		95	62	78
September		91	58	74
June	100	81	82	82
June, September		54	54	54
June, July, September		71	71	71
September		71	50	60
June	200	83	91	87
June, September		62	46	54
June, July, September		46	58	52
September		58	30	44
June	300	83	91	87
June, September		46	50	48
June, July, September		73	54	63
September		25	28	27

Results after two inoculations can be summarized as follows:

(1) Eighty-nine percent of the untreated seedlings are infected.

(2) Treatments applied only in June did not offer protection.

(3) Treatments of 300 p.p.m. applied in September alone are 27 percent infected.

(4) There was no advantage of adding 0.1 of 1 percent Triton X-155 to the aqueous solution.

(5) Treatments that received only Triton and water are 60 percent infected.

(6) No tree mortality or undesirable side effects have occurred from any treatment.

b. New studies.

Major emphasis in new seedling immunization studies was to increase antibiotic concentrations and to investigate antibiotic combinations.

(1) One study was initiated at the Coeur d'Alene Nursery in May 1963. Treatments consisted of foliar dip, complete dip, and foliar spray. Phytoactin and Venturicidin,1/ two anti-fungal antibiotics, were applied as separate dips and sprays at 300, 600, and 1,200 p.p.m. aqueous solutions to 2-1 western white pine seedlings. These two antibiotics were also combined in solution as follows: Phytoactin, 300 p.p.m., and Venturicidin, 600 p.p.m.; Phytoactin, 300 p.p.m., and Venturicidin, 300 p.p.m.; Phytoactin, 600 p.p.m., and Venturicidin, 300 p.p.m. Complete dips and foliar dips were applied when seedlings were transplanted in May. Foliar sprays were applied in June, August, and September. Some of these trees were foliar sprayed all three seasons. No treatment has shown phytotoxicity to date. All seedlings were artificially inoculated in October 1963. Preliminary results will be known in September 1964.

(2) Western white pine 2-1 seedlings received a root treatment of four different Phytoactin formulations in June 1963 at the Coeur d'Alene Nursery. Root treatments are comprised of (a) Phytoactin, 200 mg. tablet placed in the bottom of the planting hole, (b) Phytoactin, 1 percent, root slurry dip, (c) Phytoactin L-428, 22 gram, incorporated into soil before planting, (d) Phytoactin L-428 aqueous solution, root dip prior to planting, and (e) no treatment. Each treatment contained 60 seedlings planted in four groups of 15 in randomized blocks (fig. 2).

Seedling survival in September 1963 was as follows:

Treatment	Percent survival
Untreated	99
Slurry, 1 percent	100
Tablet, 200 mg.	42
L-428, 22 gr.	7
L-428, root dip	0

Tablets were recovered from some of the dead trees in the 200 mg. tablet test. Figure 3 shows Phytoactin tablet after 4 months in the soil. All seedlings were artificially inoculated in October 1963. Preliminary results will be known in September 1964.

1/ The name of Venturicidin has been changed to Murventin.

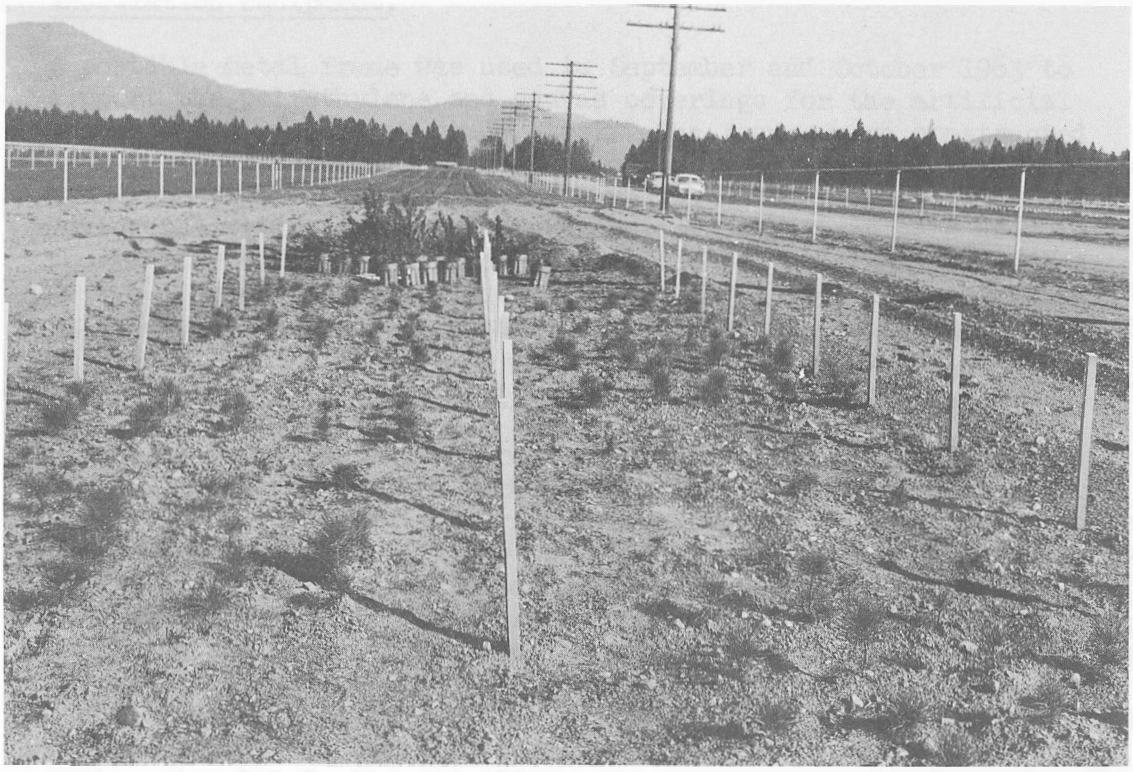


Figure 2.--Phytoactin root treatment. Note high tree mortality in certain blocks.

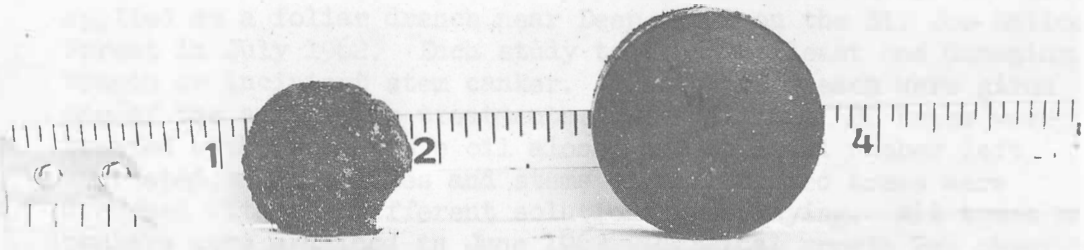


Figure 3.--Tablet on left was recovered after 4 months in the soil. Tablet on right shows original size.

2. Inoculation equipment.

A portable metal frame was used in September and October 1963 to support the polyethylene and canvas coverings for the artificial inoculations of nursery study stock. The frames were constructed of 1-1/4-inch thin wall electrical conduit and fastened together by 1-inch pipe fittings. Wheels were installed to facilitate moving the frames for short distances. Wood rafters were used to provide air circulation space between the polyethylene and canvas covers. Measurements for each unit are 10'x10'x5'6" high. Three units can be assembled together to inoculate an area 10'x30' (fig. 5).

3. Treated white pine planting stock.

Outplantings of Phytoactin-treated western white pine nursery seedlings were established on each of the five white pine Forests in May 1963. All white pine nursery stock shipped to the Forests from the Savenac and Coeur d'Alene Nurseries in the spring of 1963 received a Phytoactin, 200 p.p.m. foliar dip treatment before shipment. The outplanting study for each Forest consisted of 200 of these treated seedlings and an equal number of untreated seedlings. Mortality rates for outplantings were the same for treated and untreated seedlings when inspected in August 1963. The study plot locations were selected in recently burned over areas outside ribes eradication units where ample natural infection should occur.

Phytoactin, 400 p.p.m. aqueous solution was sprayed on all 2-0 or older white pine seedlings in both Forest Nurseries in September 1963 prior to fall planting. None of the planting stock used during the fall 1963 season received any other kind of antibiotic treatment.

4. Reproduction studies.

a. Status of 1962 studies.

A tree series of 5- to 10-year-old western white pine reproduction was treated with oil base solutions of Phytoactin L-439 and L-440 applied as a foliar drench near Deep Creek on the St. Joe National Forest in July 1962. Each study tree had at least one damaging branch or incipient stem canker. Twenty trees each were given one of the antibiotic treatments. An additional 20 trees were treated with No. 1 stove oil alone, and an equal number left untreated. All needles and stems of the treated trees were drenched with the different solutions by spraying. All trees and cankers were examined in June 1963. Terminal growth was observed to be damaged to some degree by all of the sprays. Heaviest damage occurred on the Phytoactin L-439 and the L-440 treated trees, although oil alone also damaged terminal growth to some extent.

Figure 4.--Coeur d'Alene Nursery.

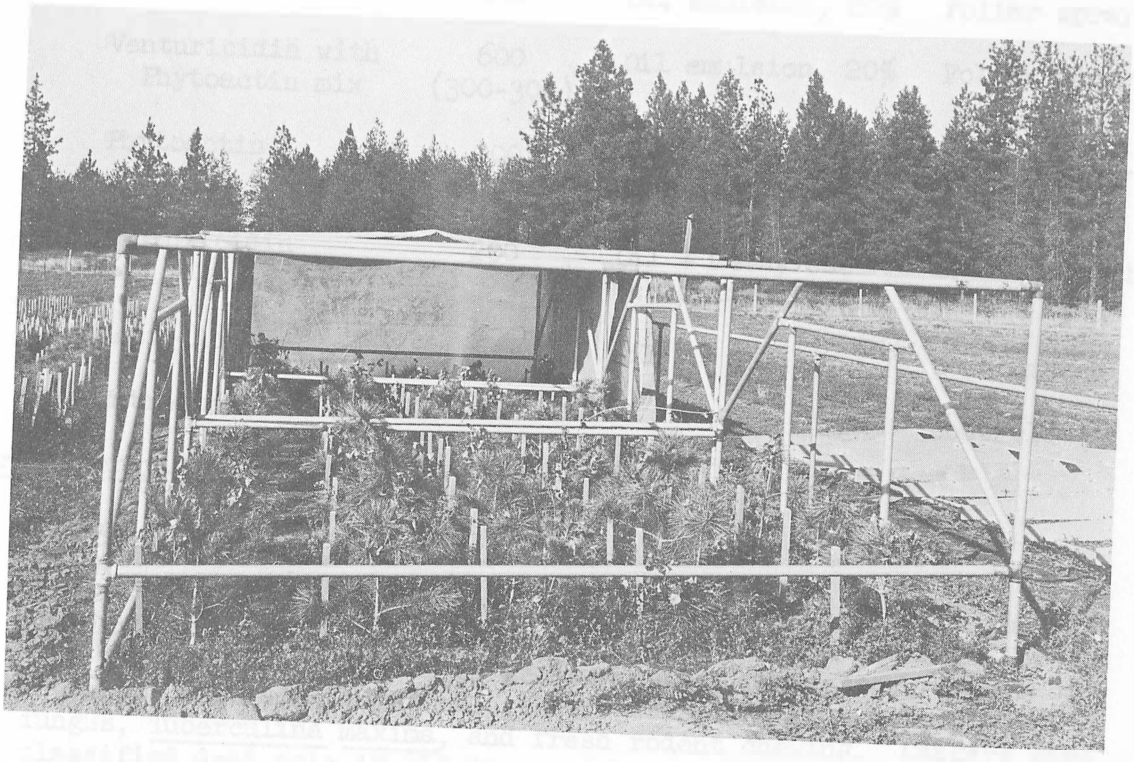


Figure 5.--Partially covered inoculation chamber.

Results to date are as follows:

Antibiotic	P.p.m.	Carrier	Percent infection control
Phytoactin L-439	200	Oil	25
Phytoactin L-440	200	Oil	22
None	--	Oil	13
None	--	--	4

b. New studies.

A series of antibiotic treatments were applied on 5- to 10-year-old western white pine in June 1963 to determine infection control and degree of immunity against new infections. A heavily infected stand outside a white pine protection unit was selected near Deep Creek on the St. Joe National Forest. Thirty trees were selected for each treatment. Most trees had more than one canker and one had eight damaging branch cankers. The outer limits of discoloration on all infections were marked with pins at time of treatment for future observations. Treatments were as follows:

Antibiotic	P.p.m.	Carrier	Method
Venturicidin	150	Oil emulsion, 20%	Foliar spray
Venturicidin	600	Oil emulsion, 20%	Foliar spray
Venturicidin with Phytoactin mix	600 (300-300)	Oil emulsion, 20%	Foliar spray
Phytoactin	200	Oil emulsion, 20% + Triton X77, 1%	Foliar spray
Venturicidin	200	Oil + methylene chloride, 10%	Canker drench
Acti-dione	300	Oil	Stem drench
Untreated	--	--	Controls

B. Aerial Spraying Studies

1. Status of tests.

Cankers were classified either live, dead, or controlled in the examination of test tree results this year. Visual criteria for live infections were based on aeciospore and pycniospore stages of the rust, bark discoloration, canker parasitism by the purple mold fungus, Tuberculina maxima, and fresh rodent chewing. Cankers were classified dead only if all diseased bark was necrotic, callus growth was visible on more than half the canker margin perimeter, and there was no evidence of any of the live criteria. Cankers were recorded controlled if there were no sporulation or recent rodent chewing, and

there had been no advancement in mycelial growth as evidenced from annual bark discoloration measurements. Controlled cankers are those with infection remnants occurring only as a small spot or spots of discoloration visually static in growth with or without Tuberculina maxima and with waning color characteristics. Several cankers classified dead in previous examinations on the absence of live symptoms were placed in this controlled category because callus growth was less than 50 percent of the original canker perimeter. Test trees in the aerial spray plots will continue to be examined each year until all infections are classified either dead or live.

Cycloheximide aerial spray tests, except for a few plots, are no longer being evaluated. A few are being carried to observe rate of canker regrowth and to provide foliage samples for cycloheximide residue studies. Cycloheximide had an inhibitory effect of sporulation that persisted through the first growing season after spraying. Thereafter, there was a gradual increase in aeciospore and pycniospore production until infections reached normal sporulation the third year after spraying. Several cankers were killed outright but regrowth and spreading of remnant infections have become quite general. This is true whether the purple mold fungus Tuberculina maxima was or was not present. Cycloheximide semicarbazone was the most promising of the derivatives followed by thiosemicarbazone and methylhydrazone. All were highly phytotoxic to western white pine causing trees to cast 2- and 3-year-old needles in less than 2 weeks after spraying.

Table 2.--Phytoactin aerial spray results

Plot no.	Stand age	Spray date	Phytoactin formulation		Grams-gallons per acre		Canker status, percent 1963 results		
			Number	Carrier	Grams	Gallons	Dead	Controlled	Live
St. Joe National Forest									
1	60-80	June 1959	L-317	water	3.8	10	51	70	1/ 30
2	60-80	June 1959	L-318	water	7.6	10	63	81	19
3	60-80	June 1959	L-319	water	15.2	10	67	86	14
Check	60-80	June 1959	Check	none	0.0	0	3	3	97
9	20-40	June 1959	L-317	water	3.8	10	53	76	24
7	20-40	June 1959	L-318	water	7.6	10	66	87	13
8	20-40	June 1959	L-319	water	15.2	10	62	83	17
Check	20-40	June 1959	Check	none	0.0	0	5	5	95
22	60-80	June 1960	L-318	water	7.6	5	44	66	34
23	60-80	June 1960	L-318	10% oil	7.6	5	48	78	22
24	60-80	June 1960	L-318	20% oil	7.6	5	56	77	23
15	60-80	June 1960	L-318	water	7.6	10	47	73	27
16	60-80	June 1960	L-318	10% oil	7.6	10	52	82	18
17	60-80	June 1960	L-318	20% oil	7.6	10	63	86	14
18	60-80	June 1960	L-382	20% oil	7.6	10	62	83	17
19	60-80	June 1960	L-387	20% oil	7.6	10	38	60	40
20	60-80	June 1960	L-390	20% oil	7.6	10	49	66	34
21	60-80	June 1960	L-395	20% oil	7.6	10	27	44	56
Check	60-80	June 1960	Check	none	0.0	0	7	7	93
Coeur d'Alene National Forest									
4	20-40	September 1960	L-318	20% oil	7.5	7	59	88	12
5	20-40	September 1960	L-395	20% oil	7.5	7	34	53	47
8	18	June 1961	L-318	20% oil	7.5	10	53	84	16
Check	20-40	June 1961	Check	none	0.0	0	4	4	96

1/ Controlled plus alive equals 100 percent. The controlled percentage includes those infections classed as dead.

Table 3.--Cycloheximide aerial spray results

Plot no.	Stand age	Spray date	Cycloheximide derivative and carrier	Grams-gallons per acre		Canker status, percent 1963 results		
				Grams	Gallons	Dead	Controlled	Live
Coeur d'Alene National Forest								
1	20-40	September 1960	Methylhydrazone 20% oil	7.6	7	14	22	1/ 78
2	20-40		Semicarbazone 20% oil	7.6	7	26	35	65
3	20-40		Semicarbazone GAB-1 - water	7.6	7	18	27	73
6	20-40		Methylhydrazone GAB-3 - water	7.6	7	11	16	84
7	20-40		Semicarbazone GAB-2 - water	7.6	7	9	11	89
Check	20-40		check	0.0	0	4	4	96
St. Joe National Forest								
12	20-40	June 1959	Semicarbazone water	7.6	10	41	54	46
Check	20-40	June 1959	check	0.0	0	5	5	95
29	60-80	June 1960	Semicarbazone 20% oil	7.6	10	38	45	55
Check	60-80	June 1960	check	0.0	0	7	7	93

1/ Controlled plus alive equals 100 percent. The controlled percentage includes those infections classed as dead.

2. New tests.

Substitution of light cycle oil (aniline point 96° F.) for western No. 1 fuel oil (aniline point between 140° and 150° F.) in the preparation of 20 percent oil emulsion in aerial spraying Phytoactin L-318 was tested in the Kootenai National Forest, Montana. Venturicidin in 20 percent oil (western No. 1 fuel oil) emulsion was also applied by helicopter to a test plot in the Coeur d'Alene National Forest, Idaho.

C. Foliar Spray Studies (Mistblower - Clearwater National Forest)

A definite need exists to develop a foliar application of an antibiotic capable of inducing disease resistance and infection eradication properties in 5- to 15-year-old white pine. This need is particularly apparent in the extensive stands of reproduction on the Clearwater National Forest and adjoining state and private lands.

Three test plots situated in a cutover area supporting natural reproduction on Potlatch Forests, Inc., lands near Pierce, Idaho were sprayed in October 1963 using a Solo Port-60 backpack mistblower. The actual mechanics of applying the antibiotic solution with the mistblower was considered to be a very successful operation warranting further tests. Trees possessing branch and stem infections with aggressively advancing margins in initial or intermediate stages of development were selected for future treatment evaluation. The treatments are described in the following tabulation:

Plot no.	Antibiotic	Spray solution: Concentration (p.p.m.)	Spray solution: Carrier	Plot area (acres)	Solution applied 1/ (gallons)	Trees treated (number)
1	None	none	20% oil emulsion	0.3	2.0 (6.6)	114 (checks)
2	Phytoactin L-318	800	20% oil emulsion	0.7	2.5 (3.6)	258
3	Phytoactin L-318	400	20% oil emulsion	0.4	2.5 (6.2)	200

1/ Number in parentheses indicates theoretical application in gallons per acre determined from amount actually used and plot size.

Additional trees treated in 1963, but not specifically reserved for treatment evaluation, are scheduled to be artificially inoculated in 1964 to assess their infection immunity. Foliage material collected 1 week after treatment will be analyzed in the laboratory in an attempt to relate quantitative measures of residual antibiotic to foliage absorption and method of application.

Basal Stem Studies

1. Three formulations of cycloheximide and three formulations of Phytoactin were tested on 10- to 15-year-old western white pine in June and September 1961. Cycloheximide formulations included Acti-dione BR, Acti-dione 3X, and Naramycin. Concentrations of cycloheximide formulations were 150 p.p.m. Phytoactin concentrations were 150, 200, and 250 p.p.m. All Phytoactin formulations were mixed in isoproponal solvent before mixing with oil. Thirty trees in each treatment were used as a tree basis. Results to date are shown in Table 4.

Table 4.--Second-year results in applying several antibiotics in the spring and in the fall seasons by the basal stem method to 10- to 15-year-old western white pine on the St. Joe National Forest.

Antibiotic formulation	P.p.m.	Lethal stem and branch cankers with negative symptoms (controlled) 2 years after treatment	
		Treatment date	
		June 15, 1961	September 15, 1961
Acti-dione + Triton B-1956	150	67	47
Naramycin	150	69	21
Naramycin + Triton B-1956	150	77	43
Cycloheximide 3X	150	52	1/--
Phytoactin L-426	150	26	27
Phytoactin L-348	200	39	13
Phytoactin L-427	250	22	31
Untreated	--	11	11

1/ No plot established in September.

2. The moisture on trunk study established in 1961 further shows that Acti-dione BR oil solution used in the basal stem method must not be applied to trees when trunk surface is wet from dew, rain, or snow. Acti-dione, 150 p.p.m., diluted in No. 1 fuel oil containing Triton B-1956 surfactant to prevent cycloheximide crystallization was applied under four trunk surface conditions: (1) trunk surface dry when sprayed, (2) sprayed dry followed by wetting surface with water, (3) surface wet with water prior to spraying, and (4) bark surface wet with water both before and after spraying.

Trunk surface treatment	Second-year results Percent cankers	
	Dead	Controlled
Dry-treat	54	71
Dry-treat-wet	21	26
Wet-treat	4	4
Wet-treat-wet	0	0
Untreated	0	0

E. Whitebark Pine Studies

(Hudson Bay Divide, Glacier National Park)

An inspection party comprised of National Park Service personnel, Forest Service Pest Control personnel, and Jack Ziffer, Pabst Laboratories, Milwaukee, Wisconsin, reviewed various antibiotic treatments on whitebark and limber pines in Glacier National Park in July 1963. Although the results of these tests are still inconclusive, some of the basal stem treatments are encouraging.

A new series of basal stem and foliar treatments on whitebark pine was recommended and initiated following the inspection trip. Suitable test trees were selected in pine stands adjacent to study plots established in 1961 and 1962 at Hudson Bay Divide. Table 5 describes the principle treatments applied in August and September 1963.

The test plots are scheduled for annual examinations to determine effects of treatment. Tree tissue and spray solution samples collected from representative treatments will be bioassayed in the laboratory to determine the presence and amount of antibiotic. A new series of foliar treatments (planned for July 1964) will be applied in the flush growth period using a gasoline-powered backpack mistblower. Foliar treatments will receive first priority in future tests since the extensive stands of limber and whitebark pine present in the West can probably be most effectively treated by this method of application.

Table 5.--Basal stem and foliar treatment of whitebark pine in August and September 1963 at Hudson Bay Divide, Glacier National Park

Treatment	Antibiotic	Spray solution		No. trees	Number cankers
		Treatment, p.p.m. concentration	Carrier		
Checks and controls	None	None	None	80	220
Basal stem and direct canker1/	Phytoactin L-440	200	Oil	20	54
	Venturicidin	200	Oil	20	74
	Phytoactin L-440 with Venturicidin mixture	200	Oil	20	62
Foliar spray	Phytoactin L-440	200	Oil	30	73
	Venturicidin	200	Oil	20	69
	Phytoactin L-440 with Venturicidin mixture	200	Oil	20	44
Foliar spray	Phytoactin L-318	200	20% oil emulsion	30	64
	Phytoactin L-318	400	20% oil emulsion	20	63
	Phytoactin L-319	400	20% oil emulsion	20	64
	Venturicidin	200	20% oil emulsion	20	54
	Phytoactin L-318 with Venturicidin mixture	200	20% oil emulsion	10	24
	Phytoactin L-461	200	20% oil emulsion	10	23
	Phytoactin L-462	200	20% oil emulsion	10	18
Foliar spray	Phytoactin L-383	200	Water	10	27
Miscellaneous absorption and translocation studies				135	81
				475	1,013

1/ Perimeters of stem cankers and lower trunk surfaces on half of the trees were scarified with a chisel-type implement fitted with a rowel.

F. Cooperation

Basic research in Phytoactin activity under the Washington State University-Pabst Laboratories cooperative project has two objectives: (1) to develop qualitative and quantitative chemical, biological, or serological assay procedures for Phytoactin concentrations in treated plant tissues, and (2) to measure the efficacy of Phytoactin uptake, distribution, and accumulation in plant tissues in relation to environmental and physiological conditions. Progress was made during 1963 in the isolation, purification, and measurement of Phytoactin or its derivatives from treated plant tissues. The Phytoactin study is under the direction of Dr. C. Gardner Shaw, Department Chairman, and Dr. S. O. Graham, Associate Professor and Plant Pathologist, Department of Plant Pathology. Three graduate students, Alan Harvey with stipend provided by Pabst Laboratories, and Simean Leach and Martin Stoner with stipend provided by the Department of Plant Pathology through the Washington State Agricultural Experiment Station, have assisted in the study.

Canadian and United States forestry and industrial visitors in calendar year 1963 included:

Pabst Laboratories

Dr. Alex Sigal - Technical Director, Microbiological and Chemical Research, Milwaukee, Wisconsin
Dr. Jack Ziffer - Director of Microbiological Research, Milwaukee, Wisconsin

British Columbia, Canada

D. R. Glew - Forester, Management Division, British Columbia Forest Service, Victoria, B.C., Canada
S. Z. Cinar - Forester, Management Division, British Columbia Forest Service, Victoria, B.C., Canada
Philip G. Haddock - Associate Professor, Faculty of Forestry, University of British Columbia, Vancouver, B.C., Canada
L. C. Weir - Forest Pathologist, Forest Entomology and Pathology Branch, Department of Forestry, Victoria, B.C., Canada
W. S. Hough - Silviculturist, Forest Service, Office of District Forester, Nelson, B.C., Canada

U.S. Forest Service

John R. Hansbrough - Director, Division of Forest Disease Research, Washington, D.C.
Conrad P. Wessela - Head, Section of Disease Control, Washington, D.C.

III. DEVELOPMENT OF BLISTER RUST RESISTANT WHITE PINE - 1963

Developmental work under the long-range program for breeding blister rust resistant western white pine entered its fourteenth year in 1963. Occurrence of a bumper white pine flowering year materially aided the work. In fact, heavy male and female flowering so accelerated the test crossing work that the standard four test cross pollinations were completed on a total of 111 new "candidate" trees; this was almost double the number of new candidates covered in any previous season.

This developmental work is performed by Intermountain Station personnel, but is financed - under Memorandum of Understanding - by Region 1. A scientist-technician team undertakes annually about 4-1/2 man-years of work, aimed at the practical aspects of mass production of semiresistant white pine planting stock. The underlying breeding scheme and progress thereunder are outlined in Table 1.

Table 1

Steps in the breeding scheme	Progress through 1963
1. Selection of rust-free "candidate" trees in unprotected, heavily infected natural stands.	385 candidates located (400 wanted).
2. Controlled crossing of candidates using pollen from four "test" trees.	310 candidates test-crossed.
3. Resistance testing of F_1 test-cross progenies, commencing with artificial inoculation and continuing with annual rust examinations.	210 candidates, each with four F_1 test-cross progenies in nursery, 170 with F_1's inoculated once or more.
4. Reselection of candidates for general combining ability for resistance, i.e., on the basis of all four test-cross progenies exhibiting significantly better rust survival than controls.	25-30 candidates reselected out of 110 fully or tentatively appraised.
5. Remating of "general-combiner" candidates, both from within the same elevational zone.	14 general-combiners remated in 7 F_1's.
6. Culling of general-combiner F_1 progenies by artificial inoculation to eliminate susceptible types, then conservation of surviving seedlings to multiply scionwood.	3 general-combiner F_1's representing 6 reselected candidates now in the scionwood "bank."
7. Establishment of F_2 seed orchards for production of low-, mid-, and high-elevation seed.	Grafting scheduled to begin in 1970, rootstocks under production for 1966 establishment.

In 1963 we have about reached the halfway point in the work. Each successive year the various candidates move downward, through the steps of Table 1. In the period 1965-1970 we should reach the goal of about 25 reselected trees for each of three elevational zones, remated within elevational zones to provide half that number of general-combiner F_1's.

Present plans call for grafting of scionwood from the oldest of these, beginning in 1970 and continuing with about 20 acres of seed orchard (2,000 grafts) per year through 1974. Preplanted rootstocks will then be 8-11 years old, scions from the "bank" will be mostly from 6-year-old F_1's. Seed produced after about 1985 will be unselected F_2 seed and should average better than 50 percent survival under root conditions in the field.

Research work in advanced-generation breeding, in interspecies breeding, and in biochemistry of rust resistance continues. The Intermountain Station finances this work, amounting annually to about 3-1/2 man-years of work.

IV. MECHANICAL IMPROVEMENTS FOR WHITE PINE BLISTER RUST CONTROL - 1963

A. Stake Truck Slip-on Tanks for Water and Oil Supply Service

1. There were three additional flat-topped, round-bottomed, 10 gage steel slip-on tanks purchased for use in 1963.

   These tanks are 6 inches longer than the 1962 model and have a capacity of 960 gallons. Established mixing practice requires a ratio of 80 gallons of water to 20 gallons of fuel oil. The largest batch requires 720 gallons of water. The excess 240 gallons of water is carried over in storage which increases to 720 gallons with two additional truck supply trips.

2. A double section 10-gage tank of 1,380-gallon capacity was also purchased. This tank is shaped similarly to the 960-gallon units. Larger in dimension, it is 132 inches long by 76 inches wide by 32 inches high. The front tank section is 77 inches long and holds 805 gallons. The rear section is 55 inches long and has a capacity of 575 gallons.

   This tank is also mounted on two 4"x6"x144" skids. The front section has two baffles and the rear has one. Each section has a 6-inch fill opening. Two 2-inch outlet pipes are supplied with valves at the rear of the tank. A three-valve manifold gives full control of each compartment. This large unit is carried to helispots on a stake-side truck and used for both water and oil storage. The two-sectioned tank is desirable in limited space areas.

B. Mixing-Service Tanker for Antibiotics

1. A seventh antibiotic mixing-service tanker was completed in the spring of 1963. This unit is equipped with a 210,000-grain water softener.

2. Purchase of extra tri-rotor pumps for mixing-service tankers was made in an effort to prevent field delays from pump failures. Three tri-rotor pumps, model 80-BV-2", were obtained and reconditioned for field service.

C. Water Conditioning for Antibiotic Sprays

Variations in water hardness and hydrogen-ion concentration throughout the Region required specialized equipment to minimize their effects on the antibiotic spray solutions. Prespray water testing with subsequent addition of prescribed quantities of sodium bisulfate adjusts the water pH satisfactorily. Softeners were installed at four mixing tanker stations to treat the water before it was placed in an antibiotic spray emulsion.

1. In June, a Bruner model R120-1", 120,000-grain, one-tank softener was purchased. It was equipped with a single lever, 3-position control valve and timer. This softener was supplied with Dowex high capacity resin. Average flow rate is 18 gallons per minute.

An Oberdorfer #1P378, 1-inch geared pump powered by a 5 H.P. Wisconsin engine supplied the water for the softener. The softener was mounted on an Army surplus bomb trailer beside a 1,700-gallon aluminum supply tank. Water was often pumped directly from a stream through the softener and then to the supply tank. The antibiotic mixer pump draws the soft water directly from the aluminum supply tank.

2. Three Bruner model 210C-1½ single lever, multiport, one-tank softeners were purchased in July and installed on antibiotic mixing tankers. These 210,000-grain softeners contain 7 cubic feet of Dowex-ion exchange high capacity resin. Flow rate is 35 gallons per minute maximum. Eighty pounds of Wisconsin flint sand were added as a topping on the filter beds. This was placed directly below the regular resinous bed to guard against "channeling."

A Marine Products Co., model 6200, 1½" geared pump, belt-driven from the mixer engine, supplied water to the softener. Water is pumped through the softener to a supply tank beside the antibiotic mixer. Because of excess gear wear, softener service pumps were replaced with 1½" centrifugal pumps.

In order to clean the water before it enters the softener, a Jacuzzi model FGF-15, seven-element spin-type water filter was installed on each of the 210,000-grain softeners. These are piped in such a manner that they may be recharged with diatomaceous earth once or twice daily. Pressure paint pots were used as recharging chambers. These filters are lightweight and encased in a stainless steel shell. Contaminants may be washed into a waste area.

Filters were first installed without valves for backwashing. It was then necessary to remove the elements for thorough cleaning. They will be replumbed to provide for backwashing and cleaning with one of the synthetic liquid cleaners.

Performance of the filters and softeners was satisfactory. Soft water was always available in ample supply. Some streams yield water filled with crusty hard particles, fine mossy substances, and syrup-like algae which are caught up in the filters.

Recharging of the resin is done with pellet salt marketed as hay and stock salt. Fifty-five pounds are used for the R120, 120,000-grain unit and 100 pounds for regenerating the 210C-1½, 210,000-grain machine.

Field water testing for hardness at the softener outlet was done with the standard soap test kit.

The increase in softener size from 120,000-grain to 210,000-grain doubled the flow of soft water. The slower rate of the small softener requires additional pumping time and storage facilities.

D. Scarifier Spray Wands

There were 249 spray wands equipped with rolling punch and stainless steel top blade distributed to the Forests and National Parks in 1963. The top blade will be extended and made reversible. The following illustration shows the unit with the reversible blade. The extra length should prevent nozzle damage when scarifying the callused bark around a white pine canker prior to spraying with an antibiotic.

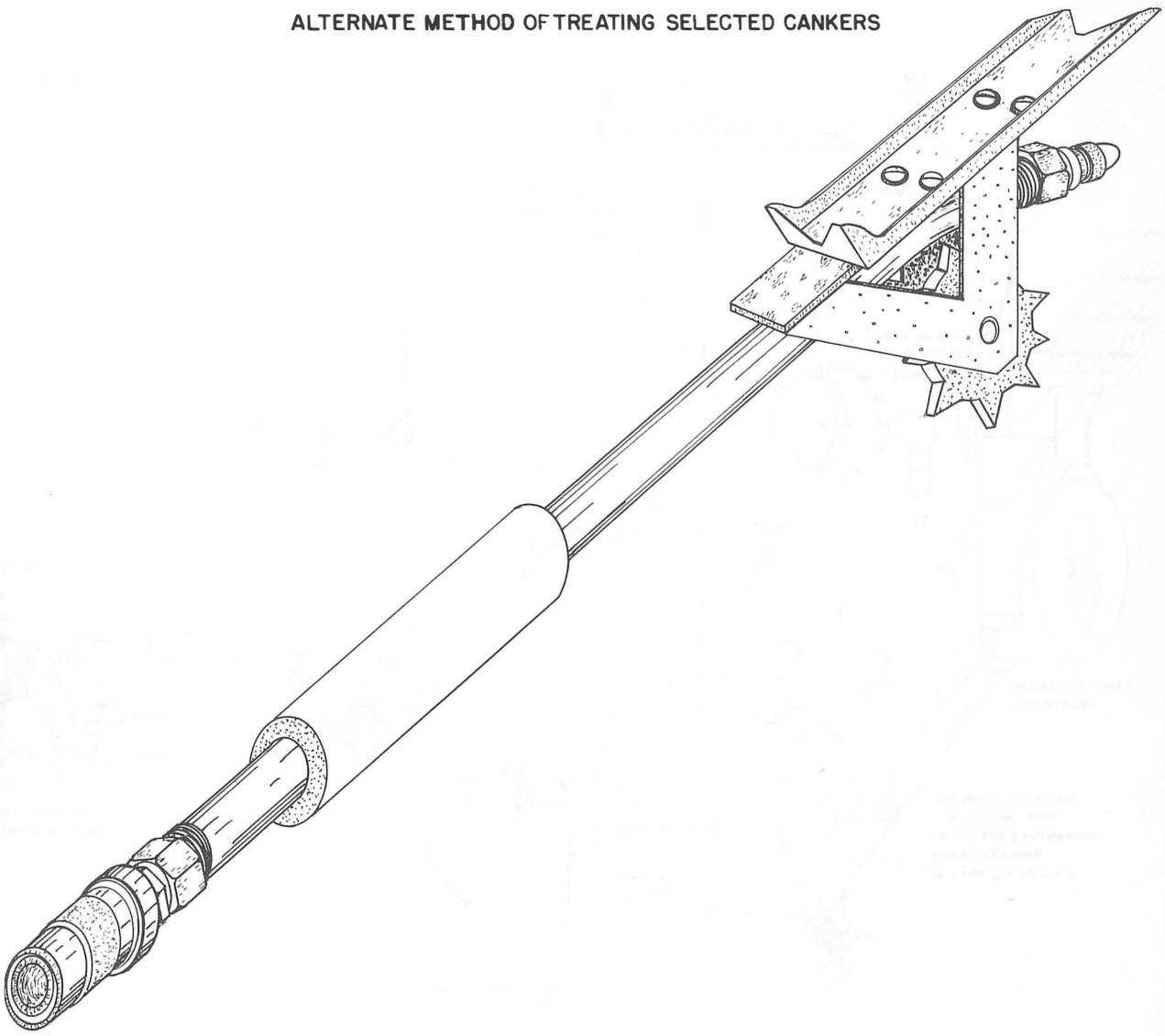
SCARIFIER

SPRAY WAND

THE STAINLESS STEEL TOP BLADE IS REVERSIBLE

INCISION BY THE USE OF THE ROLL PUNCH IS MADE AS AN

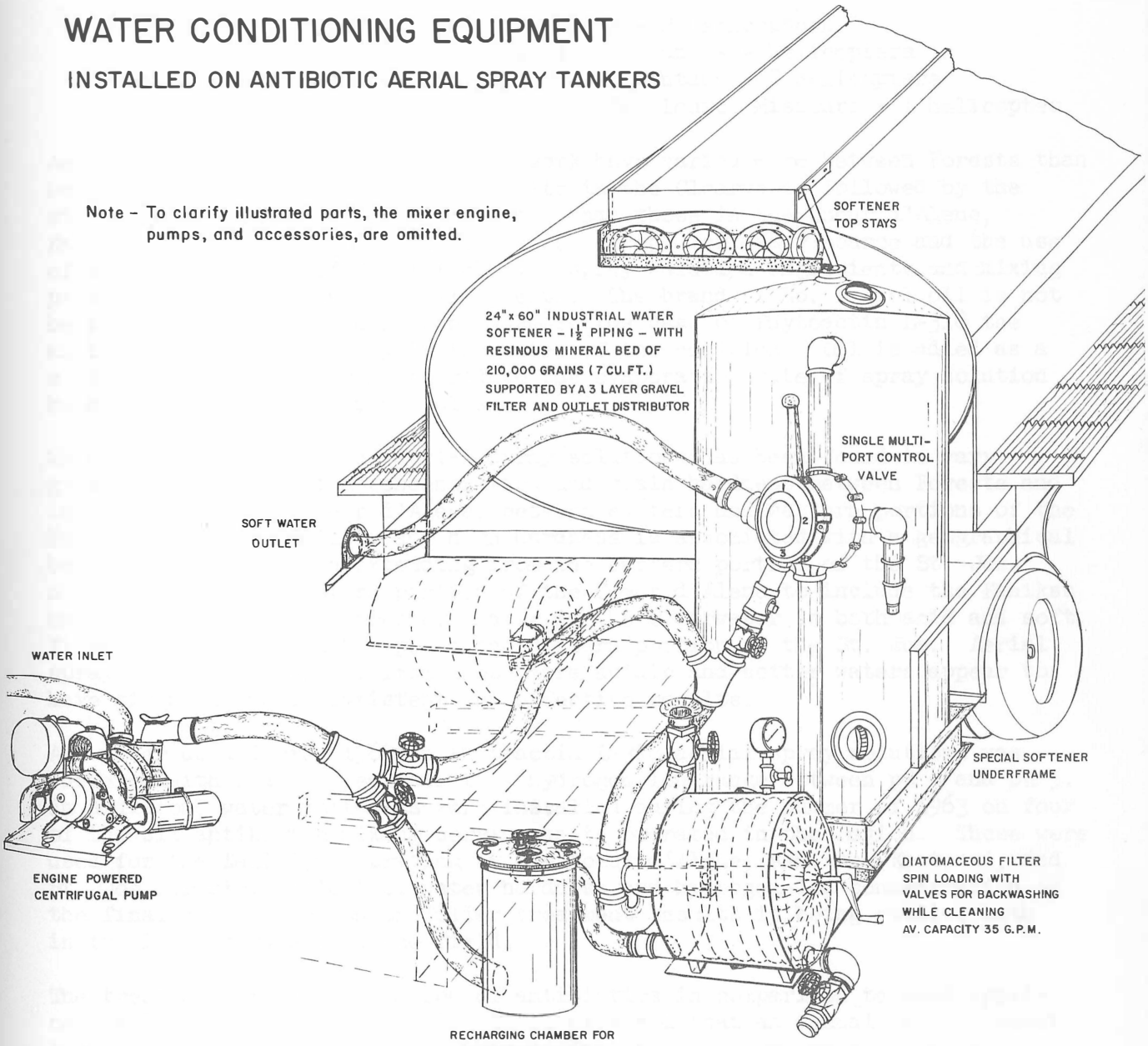
ALTERNATE METHOD OF TREATING SELECTED CANKERS



WATER CONDITIONING EQUIPMENT

INSTALLED ON ANTIBIOTIC AERIAL SPRAY TANKERS

Note – To clarify illustrated parts, the mixer engine, pumps, and accessories, are omitted.


SOFTENER TOP STAYS
24"x 60" INDUSTRIAL WATER SOFTENER – 1½" PIPING – WITH RESINOUS MINERAL BED OF 210,000 GRAINS (7 CU. FT.) SUPPORTED BY A 3 LAYER GRAVEL FILTER AND OUTLET DISTRIBUTOR
SINGLE MULTI-PORT CONTROL VALVE
SOFT WATER OUTLET
WATER INLET
SPECIAL SOFTENER UNDERFRAME
ENGINE POWERED CENTRIFUGAL PUMP
DIATOMACEOUS FILTER SPIN LOADING WITH VALVES FOR BACKWASHING WHILE CLEANING AV. CAPACITY 35 G.P.M.
RECHARGING CHAMBER FOR DIATOMACEOUS EARTH

V. AERIAL APPLICATION OF ANTIBIOTICS - 1963

All aerial spraying in 1963 was done with helicopters. The same formulation used in the fall of 1962 of Phytoactin L-318 emulsified in an 80 percent water and 20 percent No. 1 fuel oil with Multi-Film L (surfactant) was used again on all areas. All 1963 spraying was at a rate of 7 gallons with 7.5 grams of Phytoactin L-318 per acre. A total of 12 helicopters were used during both the spring and fall spray seasons. These helicopters were contracted from the following firms:

Avery Aviation, Inc., Greybull, Wyoming - 2 helicopters
Hillcrest Aircraft Co., Inc., Lewiston, Idaho - 4 helicopters
Johnson Flying Service, Inc., Missoula, Montana - 5 helicopters
Mississippi Valley Helicopters, Inc., St. Louis, Missouri - 1 helicopter

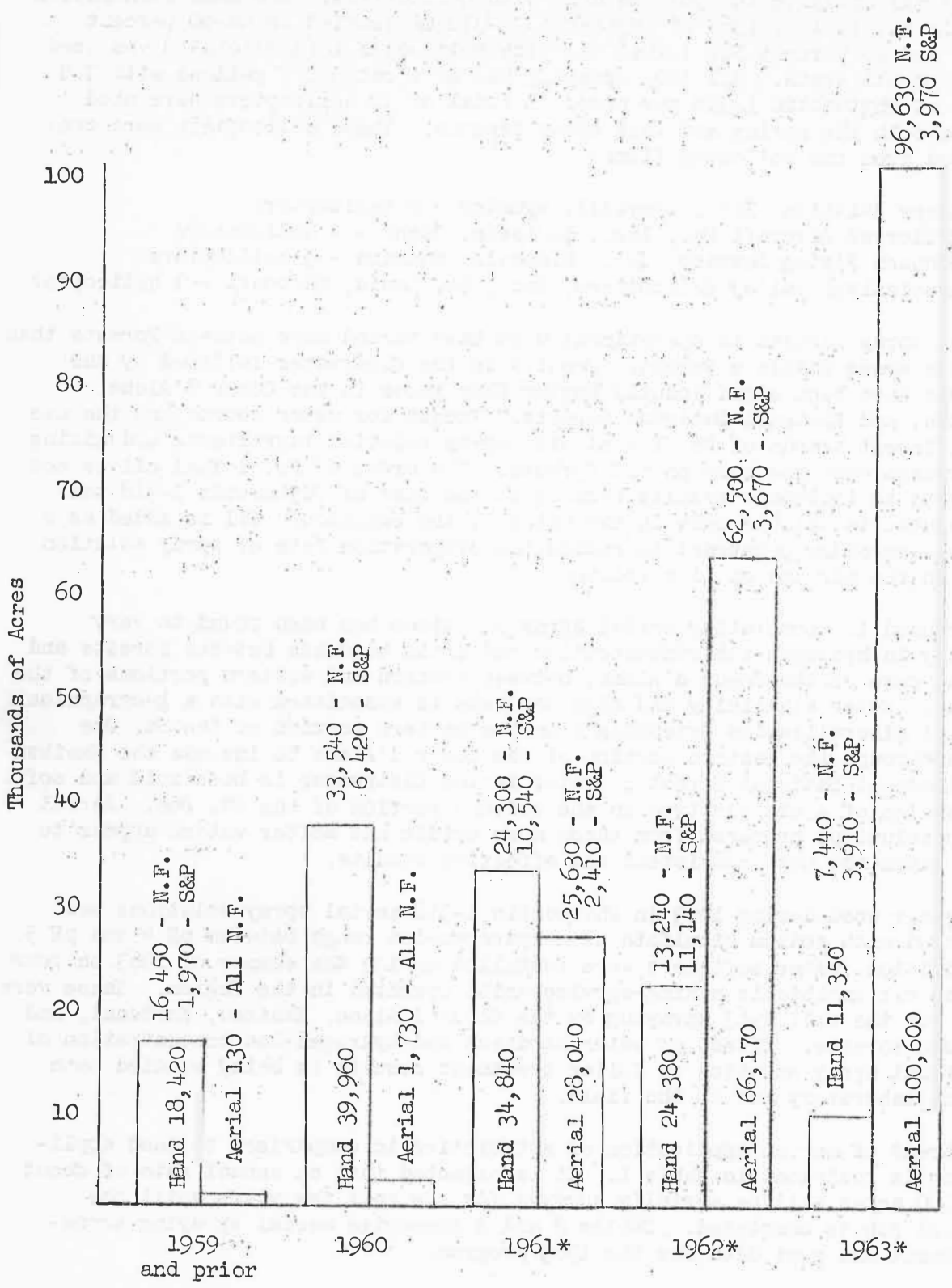
Aerial spray results in operational work have varied more between Forests than between areas within a Forest. Results in the Clearwater followed by the St. Joe have been significantly better than those in the Coeur d'Alene, Kaniksu, and Kootenai National Forests. Except for water source and the use of different brands of No. 1 fuel oil, spray solution ingredients and mixing procedures were the same on all Forests. The brand of No. 1 fuel oil is not believed to influence results because in the case of Phytoactin L-318 the antibiotic is soluble only in the water of the emulsion. Oil is added as a sticker-spreader-penetrant to reduce the evaporation rate of spray solution both in the air and on pine foliage.

Water used in formulating aerial spray solutions has been found to vary greatly in hydrogen-ion concentration and grain hardness between Forests and in the case of the Coeur d'Alene, between eastern and western portions of the Forest. Water alkalinity and high hardness is associated with a geographical belt of mineralization extending from the eastern portion of the St. Joe north through the eastern portion of the Coeur d'Alene to include the Kaniksu and Kootenai National Forests. Water in the Clearwater is both acid and soft. It is also of a similar type in the western portion of the St. Joe. Aerial spray solutions prepared from these more acidic and softer waters appear to have given the most consistent and effective results.

All water used during 1963 in Phytoactin L-318 aerial spray solutions was buffered with sodium bisulfate to a hydrogen-ion range between pH 4 and pH 5. In addition, water softeners were installed during the summer of 1963 on four of the six antibiotic mixing-service units operated in the Region. These were used for the fall 1963 spraying by the Coeur d'Alene, Kaniksu, Kootenai, and St. Joe Forests. Effect of water hardness and hydrogen-ion concentration of the final spray solution on foliar treatment results is being studied both in the laboratory and in the field.

The trend of aerial application of antibiotics in comparison to hand application is reflected in Table 1. It is expected that an annual rate of about 100,000 acres will be aerially sprayed for the next few years until the initial job is completed. Tables 2 and 3 summarize aerial spraying accomplishment and cost data for the 1963 program.

Table 1.--Region 1 Summary of Antibiotic Treatment Through 1963 (National Parks not included)



*Figures include a few acres treated previously where retreatment has been necessary.

Table 2.--Production Summary of 1963 Aerial (Helicopter) Spraying

No.	Item	Forest					Total average
		Clearwater	Coeur d'Alene	Kaniksu	Kootenai	St. Joe	
1.	Acres sprayed	10,490	28,820	26,860	7,650	26,780	100,600
2.	Flight hours - actual spraying	126.7	499.6	434.7	122.4	499.0	1,682.4
3.	Flight hours - orientation	13.7	38.3	25.1	3.9	36.6	117.6
4.	Flight hours - base ferry	6.1	26.1	25.5	10.6	18.8	87.1
5.	Number of spray loads (trips)	1,086	3,165	2,841	817	3,007	10,916
6.	Gallons solution sprayed	75,968	222,823	197,360	57,371	197,704	751,226
7.	Spray trips per hour1/	8.6	6.3	6.5	6.7	6.0	6.5
8.	Gallons sprayed per hour1/	600	446	454	469	396	447
9.	Gallons solution per trip1/	70.0	70.4	69.5	70.2	65.7	68.9
10.	Gallons solution per acre	7.26	7.80	7.32	7.50	7.31	7.45
11.	Acres sprayed per hour - actual spray time1/	84.6	57.7	61.8	62.5	53.7	59.9
12.	*Acres sprayed per hour - all flight time1/	73.2	51.1	55.3	55.9	48.3	53.4
13.	Average spray time per actual flying workday1/	2.66	2.90	2.27	3.50	3.45	2.96
14.	Acres sprayed per day - all available workdays1/	140.2	132.8	105.6	153.0	152.1	136.7
15.	Acres sprayed per day - days actual spraying done1/	229.7	169.3	140.8	219.0	191.1	190.0
16.	Flight hours, survey and other	11.9	18.5	40.5	0	22.9	93.8
17.	Total BRC helicopter use - hours	158.4	582.5	525.8	136.9	577.3	1,980.9

All spraying on the Clearwater N.F. was done with Hiller 12-E helicopters. Other Forests used Bell Models G-3, G-3B, or G-3B1.

1/ Per one helicopter.

*Does not include 1963 survey or mapping time that was done for the benefit of future spraying or other reasons.

Table 3.--Per Acre Cost Summary of 1963 Aerial (Helicopter) Spraying

Item	Forest					Total average
	Clearwater	Coeur d'Alene	Kaniksu	Kootenai	St. Joe	
Acres sprayed	10,490	28,820	26,860	7,650	26,780	100,600
Phytoactin	$7.02	$7.48	$7.11	$7.29	$7.03	$7.19
Helicopter time	1.70	2.25	2.42	1.76	2.08	2.04
Salaries (all spray projects)	.82	.39	.48	.46	.31	.49
Meal subsidy and per diem	.17	.08	.11	.12	.07	.11
Fuel oil	.22	.25	.21	.26	.24	.24
Multi-Film L and $NAHSO_4$ and other spraying materials, supplies	.04	.04	.04	.05	.02	.04
Helispot construction	.11	.24	.17	.24	.01	.15
Roads and plowing snow	.10	.03	.03	.00	.00	.03
Other - equipment use, camp construction, trailers, etc.	.25	.11	.11	.16	.20	.17
Totals - Cost per acre	$10.43	$10.87	$10.68	$10.34	$9.96	$10.46

Cost of all aerial survey and mapping work done as part of the actual spray job is included. Other flying time used for surveying and mapping in preparation of future treatment plans is not included.

VI. STATISTICAL TABLES

Statistical tables summarizing accomplishments and expenditures on a calendar year basis for each program and a total of all programs is presented in this section.

An explanation of the tables for the total of all programs follows. The tables for individual programs are similar.

1. Blister Rust Control Expenditures.

   All funds expended in Region 1 including research reimbursement items for developmental work.

2. Field Organization.

   Self-explanatory.

3. Total Progress of Ribes Eradication.

   All areas worked either initially or reworked are included. The area in Table 4 and all work done with Sale Area Betterment (K-V) funds is included.

4. Chemical Eradication.

   This table shows the acres sprayed with 2,4,5-T herbicides to eradicate ribes. The application may be from truck-mounted or backpack sprayers. These data are included in Table 3.

5. Antibiotic Treatment.

   The number of trees treated are determined from random sample plot counts.

6. Surveys.

   a. Type - Ribes. Includes all types of checking, disease surveys, and pre-eradication surveys done for the purpose of ribes eradication.

   b. Type - Antibiotic. Includes all types of survey work done for the purpose of determining areas to be treated with antibiotics. Flying time directly connected with actual spraying is not included. Systematic inspection of treated areas to determine effectiveness is also included.

7. Net Acres of White Pine by Age Classes.

   This table includes all areas satisfactorily stocked with white pine. The areas reported for the National Forest, and the State and Private programs have 20 percent or more white pine stocking. All areas that have been approved for white pine management and those areas where the present stand can be brought through to maturity with the application of antibiotics alone and without ribes eradication are included

Areas of white pine sites presently unsatisfactorily stocked or protection zones are not included. The data reported for the National Forest program include only National Forest and Public Domain land. The data reported for the State and Private program include only State and Private lands.

8. Accumulative Summary of Antibiotic Treatment.

This table shows the breakdown between the presently approved white pine management units and the areas planned for antibiotic treatment only. Areas outside of the approved units warranting immediate antibiotic treatment are now being treated on a priority basis.

9. Ownership in Blister Rust Control Programs.

The area shown as National Forest program includes only National Forest and Public Domain lands. Only state and private land is included in the State and Private program. Intermingled lands have been separated and are reported in the respective programs on the basis of ownership.

White pine management units are those areas that have been approved for the continuous production of western white pine. They are the highest priority units based on volume productivity with ribes eradication that were established following the 1948 and 1949 unit analysis. Additional ribes eradication work will be necessary. Antibiotic treatment will be done where and when necessary.

Areas outside are those established stands outside of approved white pine management units that, by treating existing stocking with antibiotics, could be brought through to a merchantable size. The next crop on these lands will depend on developments in rust-resistant pine, antibiotics and economic changes.

SUMMARY OF ALL PROGRAMS

1. Blister Rust Control Expenditures, Calendar Year 1963

State	U.S. Forest Service, Region 1					National Park Service	State and Private	Total
	042	720	411	K-V	Total			
Idaho	1,496,552	27,936	102,498	194,233	1,821,219		102,075	1,923,294
Mont.	154,987			2,700	157,687	86,178		243,865
Wash.	131,487			10,344	141,831			141,831
Colo.						23,155		23,155
Wyo.	870				870	106,242		107,112
Total	1,783,896	27,936	102,498	207,277	2,121,607	215,575	102,075	2,439,257

This table includes all Regional Office and Development and Improvement Expenditures

042 - Federal funds for National Forest program.
720 - Leadership and technical direction on non-Federal lands.
411 - Federal matching funds for State and Private cooperative programs.
K-V - Stand improvement collections used for BRC on National Forest lands.

2. Field Organization - 1963

Program	Camps	Employees ribes eradication	Employees antibiotic treatment	Total employees
National Forest	16	201	163	364
National Park	5	81	46	127
State & Private	5	40	100	140
All programs	26	322	309	631

3. Total Progress of Ribes Eradication - 1963

Ownership	Acres	Man-days	Ribes	Per acre	
				Man-days	Ribes
National Forest	8,120	7,818	2,163,000	.96	266
National Park	14,090	3,900	434,000	.28	31
State & Private	1,950	1,803	111,400	.92	57
Total	24,160	13,521	2,708,400	.56	112

SUMMARY OF ALL PROGRAMS

4. Chemical Eradication - 1963

Ownership	Acres	Man-days	Ribes destroyed	Gallons of spray solution	Man-days per acre
National Forest	920	1,400	1,256,200	200,420	1.52
National Park	360	1,280	264,000	34,540	3.56
State & Private	60	30	1,600	3,200	.50
Total	1,340	2,710	1,521,800	238,160	2.02

5. Antibiotic Treatment - 1963

Ownership	Method	Acres treated	Trees treated	Gallons solution	Man-days	Helicopter hours
National Forest	Hand	7,440	1,076,400	77,060	5,211	
	Aerial	96,630	14,806,220	723,050	1,906	1,808.5
	Total	104,070	15,882,620	800,110	7,117	1,808.5
National Park	Hand	3,790	362,000	9,060	1,320	
State & Private	Hand	3,910	593,180	24,260	2,458	
	Aerial	3,970	372,010	28,790	93	79.6
	Total	7,880	965,190	53,050	2,551	79.6
All	Hand	15,140	2,031,580	110,380	8,989	
	Aerial	100,600	15,178,230	751,840	1,999	1,888.1
	Total	115,740	17,209,810	862,220	10,988	1,888.1

6. Surveys - 1963

Ownership	Type	Acres	Man-days	Helicopter hours
National Forest	Ribes	9,450	217	
	Antibiotic	277,240	1,213	61.5
	Total	286,690	1,430	61.5
National Park	Ribes	60,930	400	
	Antibiotic	1,230	10	
	Total	62,160	410	
State & Private	Ribes	1,520	32	
	Antibiotic	78,910	288	31.3
	Total	80,430	320	31.3
Total	Ribes	71,900	649	
	Antibiotic	357,380	1,511	
	Total	429,280	2,160	92.8

SUMMARY OF ALL PROGRAMS

7. Net Acres of White Pine by Age Classes - 1963

Ownership	Age classes by date of origin						Total acres
	1980-1961	1960-1941	1940-1921	1920-1881	1880-1841	1840 & prior	
National Forest	10,590	27,330	254,530	445,330	111,310	423,120	1,272,210
National Park	- - - - - - - - Not classified - - - - - - - -						101,800
State & Private	2,180	45,600	114,730	187,480	30,450	164,710	545,150
Total	12,770	72,930	369,260	632,810	141,760	587,830	1,919,160

8. Accumulative Summary of Antibiotic Treatment - 1963

Ownership	Within white pine management units		Areas outside of white pine management units		All areas	
	Total acres	Acres treated to date	Total acres	Acres treated to date	Total acres	Acres treated to date
National Forest	494,480	187,520	777,730	82,380	1,272,210	269,900
National Park	93,910	3,580	7,890	7,060	101,800	10,640
State & Private	167,440	36,000	377,710	8,270	545,150	44,270
Totals	755,830	227,100	1,163,330	97,710	1,919,160	324,810

9. Ownership of Areas in Blister Rust Control Program - 1963

	National Forest	Public Domain	National Park	State	Private	Total
White pine stocked	1,253,150	19,060	101,800	169,940	375,210	1,919,160
Protection zone areas	172,480	3,500		22,070	52,260	250,310
Total	1,425,630	22,560	101,800	192,010	427,470	2,169,470

FEDERAL LANDS

1. Forest Expenditures, Calendar Year 1963

Forest	042 funds	K-V funds	Total
Clearwater	242,469	141,692	384,161
Coeur d'Alene	462,736*	19,819	482,555
Colville**	37,000		37,000
Kaniksu	422,976	43,066	466,042
Kootenai	106,158*	2,700	108,858
St. Joe	360,966		360,966
Total	1,632,305	207,277	1,839,582

*Includes 720 funds.

**Kaniksu National Forest administers the program on the Colville National Forest.

2. Field Organization - 1963

Forest	Camps	Employees ribes eradication	Employees antibiotic treatment	Total employees
Clearwater	5	135	5	140
Coeur d'Alene	4	50	30	80
Colville	1	0	10	10
Kaniksu	3	16	54	70
Kootenai	1	0	14	14
St. Joe	2	0	50	50
All Forests	16	201	163	364

3. Total Progress of Ribes Eradication - 1963

Forest	Acres	Man-days	Ribes	Per acre	
				Man-days	Ribes
Clearwater	4,610	5,068	733,400	1.10	159
Coeur d'Alene	1,760	1,900	627,000	1.08	356
Kaniksu	1,700	820	801,100	.48	471
St. Joe	50	30	1,500	.60	30
All Forests	8,120	7,818	2,163,000	.96	266

FEDERAL LANDS

4. Chemical Eradication - 1963

Forest	Acres	Man-days	Ribes destroyed	Gallons of spray solution	Man-days per acre
Clearwater	470	700	415,200	106,570	1.49
Coeur d'Alene	380	590	444,000	77,950	1.55
Kaniksu	70	110	397,000	15,900	1.57
All Forests	920	1,400	1,256,200	200,420	1.52

5. Antibiotic Treatment - 1963

Forest	Method	Acres treated	Trees treated	Gallons solution	Man-days	Helicopter hours
Clearwater	Hand	50	11,320	930	81	
	Aerial	9,150	749,020	68,210	261	126.8
	Total	9,200	760,340	69,140	342	126.8
Coeur d'Alene	Hand	800	160,600	8,060	730	
	Aerial	28,820	7,202,500	222,820	510	564.0
	Total	29,620	7,363,100	230,880	1,240	564.0
Colville	Hand	540	91,000	9,600	490	
Kaniksu	Hand	1,450	337,000	26,800	1,510	
	Aerial	26,560	4,205,000	195,200	530	476.4
	Total	28,010	4,542,000	222,000	2,040	476.4
Kootenai	Hand	400	75,180	3,950	415	
	Aerial	7,650	1,058,000	57,370	180	136.9
	Total	8,050	1,133,180	61,320	595	136.9
St. Joe	Hand	4,200	401,300	27,720	1,985	
	Aerial	24,450	1,591,700	179,450	425	504.4
	Total	28,650	1,993,000	207,170	2,410	504.4
All Forests	Hand	7,440	1,076,400	77,060	5,211	
	Aerial	96,630	14,806,220	723,050	1,906	1,808.5
	Total	104,070	15,882,620	800,110	7,117	1,808.5

FEDERAL LANDS

6. K-V Work - 1963

Forest	Ribes eradication		Antibiotic treatment		Total	
	Acres	Man-days	Acres	Man-days	Acres	Man-days
Clearwater	9,220	4,917	50	81	9,270	4,998
Coeur d'Alene	1,240	670			1,240	670
Kaniksu	1,280	480	1/1,300	160	2,580	640
Kootenai			2/250	6	250	6
All Forests	11,740	6,067	1,600	247	13,340	6,314

This table includes survey acres.

1/ Includes 1,230 acres of aerial spray (21.7 helicopter hours).
2/ All aerial spray (4.0 helicopter hours).

7. Surveys - 1963

Forest	Type	Acres	Man-days	Helicopter hours
Clearwater	Ribes	5,520	102	
	Antibiotic	39,400	128	9.0
	Total	44,920	230	9.0
Coeur d'Alene	Ribes	3,100	90	
	Antibiotic	85,000	430	14.5
	Total	88,100	520	14.5
Colville	Antibiotic	9,510	30	0.0
Kaniksu	Ribes	430	20	
	Antibiotic	88,170	270	27.1
	Total	88,600	290	27.1
Kootenai	Antibiotic	5,660	50	0.0
St. Joe	Ribes	400	5	
	Antibiotic	49,500	305	10.9
	Total	49,900	310	10.9
All Forests	Ribes	9,450	217	
	Antibiotic	277,240	1,213	61.5
	Total	286,690	1,430	61.5

FEDERAL LANDS

8. Net Acres of White Pine by Age Classes - 1963

Forest	Age classes by date of origin						Total acres
	1980-1961	1960-1941	1940-1921	1920-1881	1880-1841	1840 & prior	
Clearwater	9,470	16,270	28,910	49,880	12,370	156,530	273,430
Coeur d'Alene	380	7,790	77,020	144,620	11,690	190,090	431,590
Colville			8,960	12,490	8,680	8,420	38,550
Kaniksu	670	1,300	75,740	151,070	63,670	47,680	340,130
Kootenai	70	1,170	2,600	33,370			37,210
St. Joe		800	61,300	53,900	14,900	20,400	151,300
All Forests 1/	10,590	27,330	254,530	445,330	111,310	423,120	1,272,210

1/ Includes 19,060 acres of Public Domain lands.

9. Accumulative Summary of Antibiotic Treatment - 1963

Forest	State	Areas within white pine management units		Areas outside of white pine management units		Total	
		Total acres	Acres treated to date	Total acres	Acres treated to date	Total acres	Acres treated to date
Clearwater	Idaho	162,550	34,180	110,880	1,570	273,430	35,750
Coeur d'Alene	Idaho	105,290	35,690	301,600	22,590	406,890	58,280
	Montana	5,760	1,230	18,940	1,990	24,700	3,220
	Total	111,050	36,920	320,540	24,580	431,590	61,500
Colville	Wash.	6,920	1,550	31,630	5,330	38,550	6,880
Kaniksu	Idaho	83,870	31,000	146,810	9,360	230,680	40,360
	Montana	9,180	6,320	24,480	3,190	33,660	9,510
	Wash.	27,400	10,860	48,390	3,280	75,790	14,140
	Total	120,450	48,180	219,680	15,830	340,130	64,010
Kootenai	Idaho	2,640	540	300	10	2,940	550
	Montana	19,370	6,970	14,900	7,820	34,270	14,790
	Total	22,010	7,510	15,200	7,830	37,210	15,340
St. Joe	Idaho	71,500	59,180	79,800	27,240	151,300	86,420
Totals	Idaho	425,850	160,590	639,390	60,770	1,065,240	221,360
	Montana	34,310	14,520	58,320	13,000	92,630	27,520
	Wash.	34,320	12,410	80,020	8,610	114,340	21,020
Grand Total		494,480	187,520	777,730	82,380	1,272,210	269,900

STATE AND PRIVATE LANDS

1. Forest Expenditures, Calendar Year 1963

Forest	Federal funds			State and private funds			Total all funds
	720	411	Total	State	Private	Total	
Clearwater	5,430	39,820	45,250	27,947	10,561	38,508	83,758
Kaniksu	3,338	1,156	4,494	13,957		13,957	18,451
St. Joe	1,346	57,269	58,615	36,050	9,560	45,610	104,225
Total	10,114	98,245	108,359	77,954	20,121	98,075	206,434

2. Field Organization - 1963

Forest	Camps	Employees ribes eradication	Employees antibiotic treatment	Total employees
Clearwater	2		60	60
Kaniksu	1		10	10
St. Joe	2	40	30	70
All Forests	5	40	100	140

3. Total Progress of Ribes Eradication - 1963

Forest	Acres	Man-days	Ribes	Per acre	
				Man-days	Ribes
Clearwater	100	63	21,800	.63	22
St. Joe	1,850	1,740	89,600	.94	48
All Forests	1,950	1,803	111,400	.92	57

4. Chemical Eradication - 1963

Forest	Acres	Man-days	Ribes destroyed	Gallons of spray solution	Man-days per acre
Clearwater	60	30	1,600	3,200	.50

STATE AND PRIVATE LANDS

5. Antibiotic Treatment - 1963

Area	Forest	Method	Acres treated	Trees treated	Gallons solution	Man-days	Helicopter hours
Within Association	Clearwater	Hand	1,910	415,280	11,340	1,569	
		Aerial	710	56,910	5,150	21	10.4
		Total	2,620	472,190	16,490	1,590	10.4
	Kaniksu	Hand	510	18,000	2,800	110	
		Aerial	300	67,000	2,200	10	8.9
		Total	810	85,000	5,000	120	8.9
	St. Joe	Hand	1,080	109,000	8,270	625	
		Aerial	30	3,000	230	1	1.0
		Total	1,110	112,000	8,500	626	1.0
	Total	Hand	3,500	542,280	22,410	2,304	
		Aerial	1,040	126,910	7,580	32	20.3
		Total	4,540	669,190	29,990	2,336	20.3
Outside Association	Clearwater	Aerial	630	47,700	4,620	20	10.3
	St. Joe	Hand	410	50,900	1,850	154	
		Aerial	2,300	197,400	16,590	41	49.0
		Total	2,710	248,300	18,440	195	49.0
	Total	Hand	410	50,900	1,850	154	
		Aerial	2,930	245,100	21,210	61	59.3
		Total	3,340	296,000	23,060	215	59.3
All Forests	Total	Hand	3,910	593,180	24,260	2,458	
		Aerial	3,970	372,010	28,790	93	79.6
		Total	7,880	965,190	53,050	2,551	79.6

STATE AND PRIVATE LANDS

6. Surveys - 1963

Forest	Type	Acres	Man-days	Helicopter hours
Clearwater	Antibiotic	16,160	148	1.9
Coeur d'Alene	Antibiotic	5,500	10	4.0
Kaniksu	Antibiotic	14,300	30	13.4
St. Joe	Antibiotic Ribes	42,950 1,520	100 32	12.0
All Forests		80,430	320	31.3

7. Net Acres of White Pine by Age Classes - 1963

Forest	Age classes by date of origin						Total acres
	1980-1961	1960-1941	1940-1921	1920-1881	1880-1841	1840 & prior	
Clearwater	1,580	38,380	46,290	18,560	11,350	49,470	165,630
Coeur d'Alene		460	8,150	31,140	2,020	21,670	63,440
Colville				7,450			7,450
Kaniksu		960	31,090	89,230	11,880	12,070	145,230
St. Joe	600	5,800	29,200	41,100	5,200	81,500	163,400
All Forests	2,180	45,600	114,730	187,480	30,450	164,710	545,150

STATE AND PRIVATE LANDS

8. Accumulative Summary of Antibiotic Treatment - 1963

Forest	Ownership and state	Areas within white pine management units		Areas outside white pine management units		Total	
		Total acres	Acres treated to date	Total acres	Acres treated to date	Total acres	Acres treated to date
	Idaho						
	State	16,840	3,610	33,050	780	49,890	4,390
Clearwater	Private	54,000	9,020	61,740	920	115,740	9,940
	Forest total	70,840	12,630	94,790	1,700	165,630	14,330
	Idaho						
	State	1,010	220	13,620		14,630	220
	Private	1,450		45,390		46,840	
	Total	2,460	220	59,010		61,470	220
	Montana						
Coeur d'Alene	Private-all	1,060		910		1,970	
	All states						
	State	1,010	220	13,620		14,630	220
	Private	2,510		46,300		48,810	
	Forest total	3,520	220	59,920		63,440	220
	Washington						
	State	710				710	
Colville	Private	880		5,860		6,740	
	Forest total	1,590		5,860		7,450	
	Idaho						
	State	25,280	4,400	20,260	2,840	45,540	7,240
	Private	12,710	50	40,270	30	52,980	80
	Total	37,990	4,450	60,530	2,870	98,520	7,320
	Montana						
	State	640		40		680	
	Private	1,960		5,540		7,500	
	Total	2,600		5,580		8,180	
Kaniksu	Washington						
	State	120		4,970		5,090	
	Private	2,180		31,260		33,440	
	Total	2,300		36,230		38,530	
	All states						
	State	26,040	4,400	25,270	2,840	51,310	7,240
	Private	16,850	50	77,070	30	93,920	80
	Forest total	42,890	4,450	102,340	2,870	145,230	7,320

8. Accumulative Summary of Antibiotic Treatment - 1963 (Con.)

Forest	Ownership and state	Areas within white pine management units		Areas outside white pine management units		Total	
		Total acres	Acres treated to date	Total acres	Acres treated to date	Total acres	Acres treated to date
St. Joe	Idaho						
	State	18,600	13,900	34,800	2,720	53,400	16,620
	Private	30,000	4,800	80,000	980	110,000	5,780
	Forest total	48,600	18,700	114,800	3,700	163,400	22,400
Grand Totals	Idaho						
	State	61,730	22,130	101,730	6,340	163,460	28,470
	Private	98,160	13,870	227,400	1,930	325,560	15,800
	Total	159,890	36,000	329,130	8,270	489,020	44,270
	Montana						
	State	640		40		680	
	Private	3,020		6,450		9,470	
	Total	3,660		6,490		10,150	
	Washington						
	State	830		4,970		5,800	
	Private	3,060		37,120		40,180	
	Total	3,890		42,090		45,980	
	All states						
	State	63,200	22,130	106,740	6,340	169,940	28,470
	Private	104,240	13,870	270,970	1,930	375,210	15,800
	Total	167,440	36,000	377,710	8,270	545,150	44,270

NATIONAL PARKS PROGRAM

1. Expenditures - Calendar Year 1963

National Park	State	National Park funds	National Forest funds	Total all funds
Glacier	Montana	86,178	2,610	88,788
Grand Teton	Wyoming	163		163
Rocky Mountain	Colorado	23,155		23,155
Yellowstone	Wyoming	106,079	870	106,949
All Parks		215,575	3,480	219,055

2. Field Organization - 1963

National Park	Camps	Employees ribes eradication	Employees antibiotic treatment	Total employees
Glacier	2		46	46
Rocky Mountain	1	16		16
Yellowstone	2	65		65
All Parks	5	81	46	127

3. Total Progress Ribes Eradication - 1963

National Park	Acres	Man-days	Ribes	Per acre	
				Man-days	Ribes
Rocky Mountain	1,060	820	155,000	.77	146
Yellowstone	13,030	3,080	279,000	.24	22
All Parks	14,090	3,900	434,000	.28	31

4. Chemical Eradication - 1963

National Park	Acres	Man-days	Ribes destroyed	Gallons of spray solution	Man-days per acre
Rocky Mountain	140	550	138,000	16,540	3.93
Yellowstone	220	730	126,000	18,000	3.32
All Parks	360	1,280	264,000	34,540	3.56

5. Antibiotic Treatment - 1963

National Park	Method	Acres treated	Trees treated	Gallons solution	Man-days	Man-days per acre
Glacier	Hand	3,790	362,000	9,060	1,320	.35

6. Surveys - 1963

National Park	Type	Acres	Man-days
Glacier	Antibiotic Ribes	1,230 970	10 30
Rocky Mountain	Ribes	580	30
Yellowstone	Ribes	59,380	340
All Parks		62,160	410

7. Control Status - 1963

National Park	Total acres	Unworked areas	Worked area	
			Needing rework acres	On maintenance acres
Glacier	6,010		1,820	4,190
Grand Teton	1,010		100	910
Rocky Mountain	12,650	2,990	1,060	8,600
Yellowstone	74,240	26,220	8,940	39,080
All Parks	93,910	29,210	11,920	52,780

8. Accumulative Summary of Antibiotic Treatment - 1963

National Park	Acres within ribes eradication units		Acres outside ribes eradication units		Total	
	Total acres	Acres treated to date	Total acres	Acres treated to date	Total acres	Acres treated to date
Glacier	6,010	3,580	7,890	7,060	13,900	10,640
Grand Teton	1,010				1,010	
Rocky Mountain	12,650				12,650	
Yellowstone	74,240				74,240	
All Parks	93,910	3,580	7,890	7,060	101,800	10,640*

*Glacier National Park has an antibiotic treatment program. All other Parks are on a ribes eradication protection program only.

WHITE PINE BLISTER RUST CONTROL

Annual Report
Calendar Year 1964

U.S. DEPARTMENT OF AGRICULTURE
FOREST SERVICE
REGION ONE

MISSOULA, MONTANA

1380 (3000)

UNITED STATES DEPARTMENT OF AGRICULTURE
FOREST SERVICE
REGION 1

Missoula, Montana
March 1, 1965

WHITE PINE BLISTER RUST CONTROL ANNUAL REPORT
Calendar Year 1964

This report was prepared under the direction of E. H. Juntunen, Chief, Division of State and Private Forestry, by H. J. Hartman, Chief, Forest Pest Control Branch, and David A. Graham, Head, Blister Rust Control Section, from information furnished by and from the following:

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The following agencies are conducting or are actively cooperating in white pine blister rust control:

U.S. Forest Service
National Park Service
State of Idaho
Clearwater Timber Protective Association
Potlatch Timber Protective Association
Priest Lake Timber Protective Association
Bureau of Land Management
University of Idaho
Washington State University

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Region 1

Division of State and Private Forestry
Branch of Forest Pest Control

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I. HIGHLIGHTS OF 1964 BLISTER RUST CONTROL PROGRAM

THE OVERALL BLISTER RUST CONTROL PROGRAM

General

A total of 128,600 acres of white pine was treated for blister rust control in 1964. Total National Forest and State and private control program accomplishment on lands of all ownerships was 108,490 acres. The National Park control program accomplishment was 20,110 acres. A total of 588 employees were engaged in blister rust control activities during the season; 477 on National Forest and State and private programs, and 111 on National Parks program. With the exception of helicopter contracting, no work was done by contract during 1964.

The National Forest and State and private control program included some 11,590 acres of immature western white pine treated with antibiotics by the basal stem method. Phytoactin L-318 was applied as a foliar spray by helicopters on 88,860 acres of western white pine. This required 1,755 flying hours, including 90 hours of survey time. Ribes were eradicated from 8,930 acres; 7,920 acres by hand methods and 1,010 acres by chemical methods, using 2,4,5-T herbicide solutions and power sprayers.

The National Park program included 1,880 acres treated with antibiotics by the basal stem method and ribes eradication on 18,230 acres; 18,010 acres by hand methods and 220 acres by chemical methods. Total white pine areas in the National Forest and State and private program treated with antibiotics to date include 121,000 acres treated by basal stem methods and 278,000 acres treated by aerial methods. Approximately 31,000 acres within these areas have been retreated due to unsatisfactory initial treatment results. At the present rate of progress, all of the qualifying immature western white pine on National Forest lands will have been treated initially in 1969. At the present rate of progress, the immature western white pine on State and private lands will not be completely treated until 1979. Retreatment will eventually be required in most of these areas, particularly the younger stands, in order to bring the trees through to maturity without ribes eradication.

The National Park Service antibiotic treatment program is limited to Glacier Park. Approximately 2,000 acres of the 11,000 acres of white pine treated to date have been retreated.

The white pine blister rust control cooperative program with the State of Idaho, the Priest Lake, Potlatch, and Clearwater Timber Protective Associations was increased considerably during 1964. In addition to the annual 3 cents per acre which each association member pays as a contribution for blister rust control, $26,000 was allocated from the State of Idaho's

special reserve Pest Control Forest Management Fund. This marked the first year that these funds, which are collected at the rate of 5 percent from fire hazard reduction deposits, have been used for white pine blister rust control. Using matching Federal funds, as authorized by the Lea Act of April 26, 1940, this money was used to aerially spray 5,260 acres of private white pine land in Idaho. An additional $5,000 received through the Idaho State Forester from Potlatch Forests, Inc., was used in a similar manner to aerially treat 1,000 acres of company-owned white pine stands.

This special program was received favorably by all participants. An accelerated treatment program for State and private lands is urgently needed in order to save many white pine stands that are now heavily infected with blister rust.

The total State and private cooperative program including Federal matching funds approximated $250,000 during 1964.

Integrated Control Methods

The following selective methods of white pine blister rust control are being practiced and developed:

1. Control by ribes eradication in plantations under 10 years of age, or within areas specifically harvest-cut for western white pine natural regeneration.

2. Control by applying antifungal antibiotics to selected stands 10 to 100 years of age. The objective is to kill present rust infections and immunize for a period of time all treated white pine against future blister rust infections. Most of this application is done by aerial spraying using helicopters. Basal stem treatment is generally limited to stands 10 to 20 years of age, or stands otherwise not suited for aerial treatment. Ground foliar treatment will be limited to newly established (1 to 10 years) stands.

3. Nursery stock immunization by applying antibiotics to all white pine seedlings in the nursery prior to outplanting.

4. Development and mass production of blister rust resistant western white pine planting stock through applied forest genetics.

Antibiotic Treatment Results

A large amount of canker evaluation data was collected during 1964. In order to provide a basis for future evaluation of antibiotic treatments made during 1964, a total of 3,180 cankers on 2,450 trees was carefully selected, marked, and described on forms designed for this purpose. This included a representative number of untreated trees selected as controls. In addition, 4,990 cankers on 4,290 trees previously selected in areas treated in prior years or set up as controls were carefully examined for treatment effectiveness.

To date, in project treated areas, not including developmental plots, there have been 18,890 cankers on 12,980 trees selected, marked, and described in detail for evaluation purposes. This includes, as controls, 1,050 cankers on 770 untreated trees.

Many of the cankers, being currently evaluated in pole stands, are 60 feet or more from the ground with a few up to 100 feet. The use of tree grippers this year for the first time for tree climbing, greatly enhanced evaluation work and at the same time lowered unit costs.

Data from evaluations made two or more growing seasons after treatment (prior to 1963) indicate that the overall percentage of vigorous cankers controlled by basal stem treatment is 42 percent. Most of the cankers evaluated are in the treatment zone since, for stands basal stem treated, this is where the majority of lethal cankers occur. Some individual areas show 90 percent infection control. It is now apparent that all cankers treated by the basal stem method must also be scarified in order to obtain consistently good results. This practice was initiated in 1963.

No project aerial spraying was done prior to 1961. Evaluation data from the 1961 and 1962 aerially treated areas indicate that 34 percent of the vigorous cankers have been apparently controlled. Since evaluation of infections prior to the elapse of at least two growing seasons after treatment is not conclusive, no effectiveness information is available from areas aerially sprayed in 1963-64 with solutions formulated with soft water and adjusted to a lower pH range. Preliminary observations indicate that these and other more recent treatment refinements have resulted in increased infection control.

Comparative information taken from untreated areas on the same basis as that from treated areas indicates that 3 percent of the vigorous infections have become inactive.

Immunization of Western White Pine Nursery Stock

All western white pine nursery stock outplanted in 1964 received prior antibiotic treatment in an attempt to immunize those trees against blister rust for a 5- to 10-year period. In September 1964, 7.5 million nursery seedlings were foliar treated with Phytoactin L-318. No specific guarantee can be made regarding immediate or long-range benefits. Current test results appear promising. Several new tests were established in 1964.

Antibiotic Tests on Limber and Whitebark Pines

Effective antibiotic formulations and/or application techniques still have not been developed for controlling blister rust infections on limber or whitebark pines. Several new formulations were used on test plots established in 1964. Antibiotics were applied as basal stem sprays, ground foliar sprays, and aerial sprays, using a helicopter.

Spread of the Rust

Extensive scouting for new white pine blister rust infections outside the known limits of the rust, was conducted in parts of Wyoming, Colorado, Utah, and southern Idaho during 1964 with assistance from the National Park Service. Due to time and personnel limitations, only brief and rather widespread examinations were made. The year 1964 was, in general, very poor in these areas for rust development on ribes. Rust could not be found on ribes in any of several former ribes infection centers. Pinyon rust, even in known heavy infection centers for this pathogen, was very light on ribes in all areas examined. No new white pine blister rust infections were found.

Blister rust infection on ribes in the western white pine areas was, in general, moderate to light. Heavy infection was observed in a few limited areas. The 1964 fall weather appeared to be very favorable for pine infection.

Antibiotic Side Effects

No harmful side effects have been associated with proper antibiotic treatment of pine stands on 410,000 acres. No detectable damage has occurred to fish, wildlife, beneficial insects, and fungi.

Antibiotic Persistence

Little progress was made in 1964 toward determining the exact period of white pine blister rust infection immunity that will result from a single application of an antibiotic. New pine infection has not been detected in any stands properly treated with antibiotics in this Region. Artificial inoculation and bioassay studies aimed at answering this question have been initiated.

Blister Rust Damage in Mature Stands

White pine blister rust is killing mature western white pine on the Clearwater and St. Joe National Forests at a slightly more rapid rate than predicted in the 1951 and 1959 White Pine Blister Rust Control Annual Reports.

These early surveys in the Upper North Fork of the Clearwater River and the Upper St. Joe River drainages indicated, in general, that 66 percent of the mature trees were then lethally infected and that the time of death for the average lethally infected mature tree ranged between 1972 and 1980. At the time of these early surveys, dead and dying trees were evident. It has now been determined that the life expectancy of these lethally infected trees should be decreased by about 5 years.

A mountain pine beetle infestation has persisted at fluctuating levels in these same mature western white pine stands for many years. In 1964, the

number of new attacks greatly increased and the infestation is currently at a high epidemic level. This insect-disease complex is resulting in heavy mature tree mortality and will probably continue to do so. An accelerated timber harvest program with emphasis on logging for both salvage and beetle control is urgently needed.

Observations made during 1964 in mature stands aerially treated with Phytoactin L-318 in 1961 did not show that satisfactory infection control was achieved. Additional antibiotic tests in mature stands were established in 1964.

Antibiotic Research and Development

During 1964, nine scientists worked full- or part-time on basic and applied antibiotic research and development related to blister rust control. Three were stationed at the new Forest Sciences Laboratory at Moscow, Idaho; two were employed under a Phytoactin fellowship at Washington State University; and four were members of the Forest Service Methods Development and Improvement Branch at Spokane, Washington.

Economic Study

Collection of data for the new western white pine production and management economic study was continued. The original study plan which considered only blister rust protection costs has been expanded so as to include all white pine timber growing costs. The basic resource data collection job has been completed. Collection of cost data is continuing. Six employees from Research and Administration worked full- or part-time on this study which is scheduled for publication in 1966.

New Antibiotic Formulation and Application Techniques

The following formulation improvements were followed in 1964 and other new antibiotic formulations and application techniques were tested:

1. In 1964, all water used in formulating Phytoactin L-318 for aerial spraying was presoftened and the pH of the final spray solution was reduced to a range between 4.5 and 6.0.

2. All pine infections directly treated by the basal stem method in 1964 were scarified (adjacent bark broken) to increase spray solution absorption.

3. It appears that low aniline point (90° and 100° F.) oil when used as a carrier with Acti-dione BR as a basal stem treatment gives better infection control than does regular western No. 1 fuel oil which has an aniline point between 140° and 150° F. This tentative evaluation is based on observations made only 1 year following treatment.

4. Two antibiotics, vancomycin and stendomycin, were tested for the first time. Vancomycin was applied by the basal stem method directly to infections on whitebark pine. Stendomycin was applied as a foliar spray to 8-year-old western white pine reproduction.

5. The penetrant, DMSO (dimethyl sulfoxide) was used as an adjuvant for Phytoactin spray solutions applied by hand sprayer to seedlings and reproduction, and by helicopter to pole-size western white pine.

6. Phytoactin oil miscible formulations, at 1 gallon of spray solution per acre, were applied to three 40-acre plots of western white pine reproduction by helicopter. Each of the three oil miscible formulations were applied at the rate of 7.5 grams of Phytoactin per acre.

7. Phytoactin L-318 and cycloheximide solutions at low volume rates (less than 5 gallons) per acre were applied to western white and whitebark pines using a backpack power mistblower.

CLEARWATER NATIONAL FOREST AND CLEARWATER TIMBER PROTECTIVE ASSOCIATION

During 1964, 28,670 acres of State, private, and National Forest lands were treated aerially with the antibiotic Phytoactin. This was the greatest number of acres treated in 1 year from the air since the start of aerial spraying, and included 2,420 acres of private stand treatment that was financed for the first time with funds provided by the State of Idaho from their reserve Pest Control Forest Management Fund, and 1,000 acres of white pine land owned by Potlatch Forests, Inc., who paid 50 percent of the treatment costs. Federal funds were used to match these private contributions as authorized by the Lea Act of April 26, 1940. Initial aerial application was completed in the Alder, Beaver, Musselshell, Orofino, Deadwood, Independence, Pine, and Hook-Cottonwood Creek white pine areas. Initial application was started in Rock, Grizzly, Cougar, Wolf, Saddle, Wall, Bald Knob, and Lower and Middle Quartz white pine areas.

There were 198 employees on blister rust control in 1964. Five of seven field camps spent a major part of their time on initial ribes eradication in areas control-burned and prepared for planting. Since current Forest plans call for planting 1,600 acres to white pine each season, an extensive annual eradication program will be needed. Seven hundred acres were treated with herbicides to eradicate ribes within the Independence, Osier, Alder, Dewey, Brady, Musselshell, Armstrong, and Rosebud white pine areas. Hand ribes eradication was performed on an additional 2,400 acres in these and the Orofino, Lolo, Nevada, Sheep Mountain white pine areas. Spot rework of most of the chemically treated ribes areas and portions of the hand work areas will be needed in 1965 to clean up missed bushes and resprouts. This is particularly true wherever control burns were not too successful. One camp also did some retreatment with antibiotics on a portion of the Alder and Beaver Creek plantations where examination showed that the original treatment results were not satisfactory.

Two camps hand treated trees with antibiotics in stands of natural reproduction on State and private lands in the Deer and Hildebrand Creek white pine areas. A total of 2,160 acres was hand treated with antibiotics this season.

Aerial spraying of pole size and young mature stands within the Canyon Block began this year. Stands selected for treatment will not be cut within 10 years. This is an effort to reduce the increasing losses by blister rust that would occur as indicated by previous surveys.

More than 96,000 acres were surveyed this season for ribes status, antibiotic evaluation, preantibiotic treatment, and stocking and damage surveys of reproduction and mature stands.

Less than 3 percent of the total effective man-days available were lost to fire control activities. Some additional effective time was lost because of an unusual amount of rain in mid-July and the first part of August.

On the Kelly Creek District, 340 acres were control-burned in 1964 in preparation for planting, mostly to western white pine. Burning conditions were not ideal this year and some 30 acres will need to be reburned before planting can be done. Since the ribes potential in this area is high, some difficult eradication is anticipated.

During early October, two backpack mistblowers were used to treat reproduction under 10 years of age with several varying foliar Phytoactin formulations. The invert emulsions used were too heavy for the machine and required too much application time. No mechanical trouble was encountered during the 1 week these blowers were used. Excessive dew in the mornings limited the use of the machines to 4 to 5 hours each day. Portions of this test area will be artificially inoculated in order to determine immunization effects.

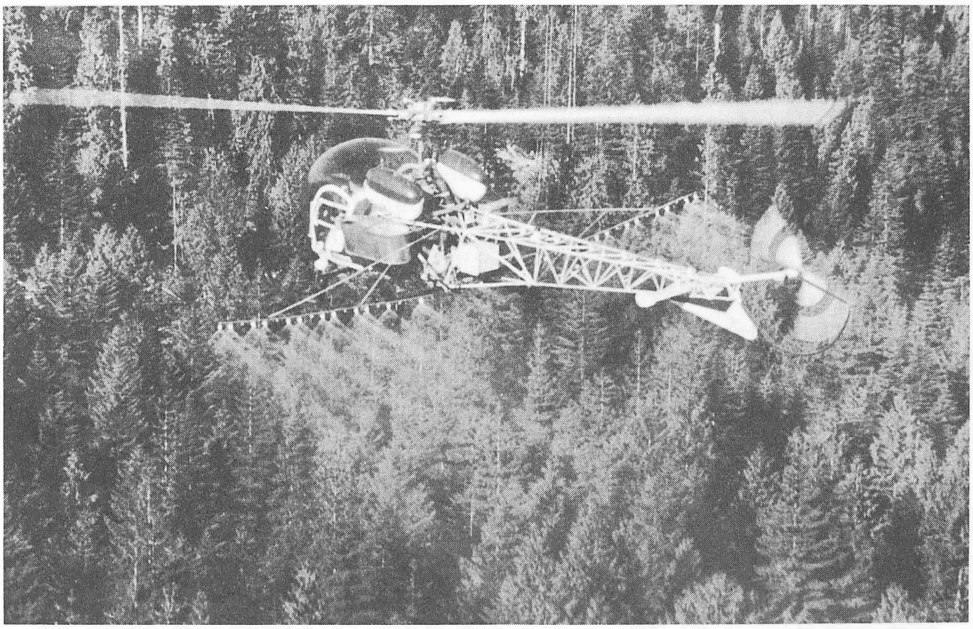
Ribes eradication work included 320 acres treated with 2,4,5-T and Tordon by helicopter to test the effectiveness of the aerially applied chemicals to varying age classes and species of ribes. Three areas were treated; two with 2,4,5-T and one with Tordon. One of the areas treated with 2,4,5-T had ribes 2 years old or less and the other had ribes 4 or more years old. Tordon was used in a contiguous block on the older age-class ribes.

Dybar was also applied to a group of preselected plots in varying amounts on an individual ribes bush treatment basis. Final results on all of these areas will not be known until the end of the 1965 season.

Some of the aerial antibiotic treatment was done in 1964 with three and four helicopters operating at the same time from one helispot. This required larger helispots and the construction of four operating pads at each; but resulted in an overall saving of manpower and equipment.

Experimental plots established in the Scofield drainage by Dr. James W. Kimmey, Intermountain Forest and Range Experiment Station, to test antibiotics effectiveness were sprayed with a project helicopter on May 18 and 19. This completed treatment of a plot series that was established during 1963 but not treated because of poor weather conditions.

Safety was continually stressed as a part of all work programs. The blister rust control project had 20 reportable accidents, one of which resulted in lost time.



Bell Model G-3B applying Phytoactin L-318 solution to young mature western white pine, Clearwater National Forest.

Backpack power mistblower being used on an experimental plot to apply Phytoactin solution to western white pine reproduction, Clearwater National Forest.

COEUR D'ALENE NATIONAL FOREST

In 1964, a total of 25,260 acres were treated, by all methods, for control of white pine blister rust. This included aerial antibiotic treatment on 23,240 acres, basal stem treatment on 150 acres, and ribes eradication on 1,870 acres by hand and chemical methods.

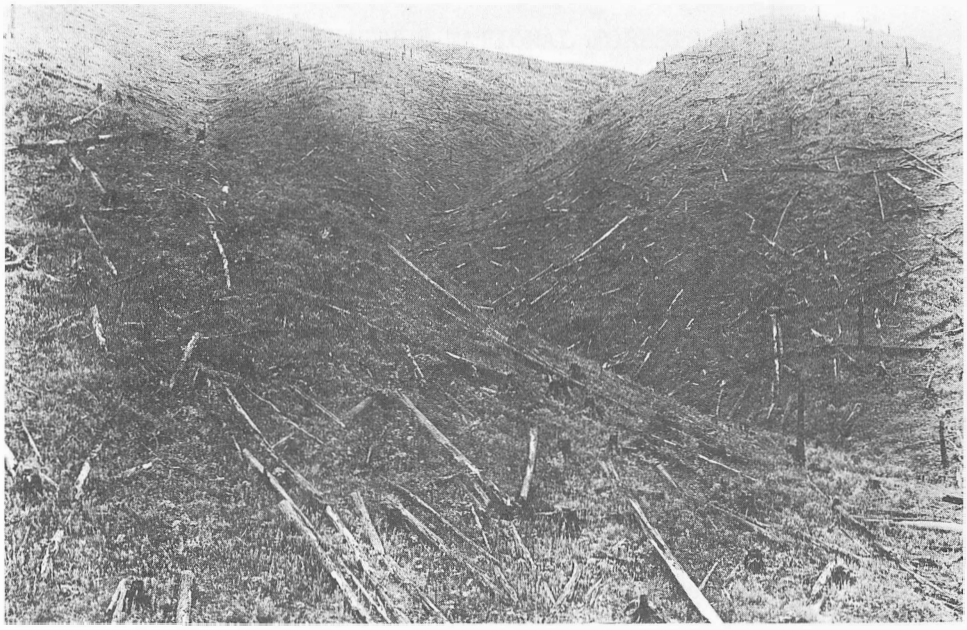
Due to the increased use of aerial spraying for blister rust control, the downward trend in number of seasonal employees continued in 1964. The total of 70 who were employed were stationed at Hudlow, Trail, and Shoshone work centers and Potter Creek blister rust control camp.

Planned spring aerial spraying of 13,000 acres got underway on May 12 and was completed on June 30. Fall spraying of a scheduled 10,000 acres started on September 3 and was completed on October 7. The usual two-helicopter unit was increased to three at one location. This operation procedure offers good possibilities for reducing costs by more efficient use of equipment and personnel. It will be used in 1965 where spray areas are large enough for the safe and effective operation of three helicopters. Seven helispots were constructed for use during the spring and fall of 1965. The abnormally wet and cool field season resulted in considerable lost time on all project work, especially hand antibiotic treatment. However, this was offset somewhat by reduced fire control activities. Total effective time lost was 101 man-days. Weather conditions appeared favorable for the spread and intensification of the rust.

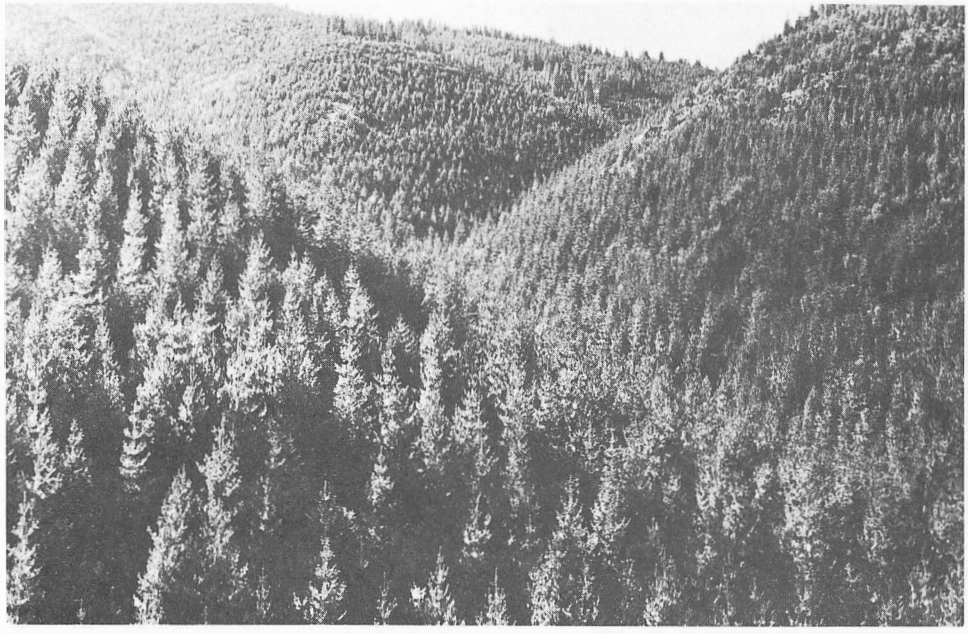
A total of 657 acres were planted to western white pine during the spring and fall planting seasons. In the Potter Creek white pine management unit, 487 acres were planted; which makes a total of 1,164 acres of white pine, and 263 acres of Douglas-fir in this plantation. Logging of merchantable material, slashing, burning, blister rust control, and planting have been continuing in this unit since 1951. An adjoining area of 215 acres, when slashed, burned, freed from ribes, and planted, will complete the conversion in this unit from an old decadent stand to a series of well-stocked and thrifty plantations.

An antibiotic effectiveness evaluation of over one thousand cankers on trees treated prior to 1962 was made by a crew of six experienced men. Check trees for future evaluation were established in most of the large blocks of pine treated in 1964. Each canker was marked with pins, measured, diagramed, and recorded. Cankers were recorded in the same manner in two untreated study areas established as controls for comparison purposes. A Swiss tree gripper was used by the evaluation crew to climb the older age-class trees for inspection of high cankers.

An intensive safety and accident prevention program was carried on throughout the season with good results. The project had one chargeable and two non-chargeable injuries, but no lost time injuries or vehicle accidents.



Brett Creek plantation area - 1944. Two years after prescribed burning, Coeur d'Alene National Forest.



Brett Creek western white pine plantation - 1963. Area was aerially treated with Phytoactin in 1961, Coeur d'Alene National Forest.

KANIKSU AND COLVILLE NATIONAL FORESTS AND PRIEST LAKE TIMBER PROTECTIVE ASSOCIATION

White pine blister rust control in 1964 was accomplished by ribes eradication and basal stem and aerial application of antibiotics. A total of 91,690 acres of white pine have been treated with antibiotics since this program began in 1957.

During 1964, 18,280 acres of white pine were treated with antibiotics. This included 12,130 acres of Federal lands--1,910 acres hand treated and 10,220 acres aerially treated; and 6,150 acres of State and private land, all aerially treated which included 800 acres of private land treatment financed with funds provided by the State of Idaho from their reserve Pest Control Forest Management Fund. Some 4,910 acres of the total State and private lands treated were within the Priest Lake Timber Protective Association.

In addition, 3,990 acres of Federal white pine stands on the Colville National Forest were aerially sprayed with antibiotics.

Ribes eradication was done on 1,080 acres of Federal land on the Kaniksu National Forest.

Seventy-five men were employed during the season at a 10-man ribes eradication camp at Goose Creek, a 20-man antibiotics treatment camp at Pelke, and at Kalispel Bay blister rust control headquarters.

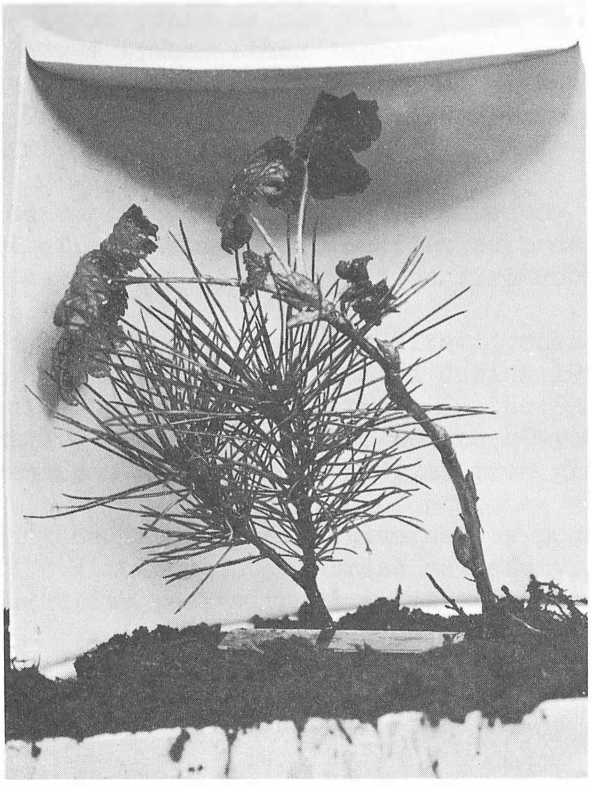
Twelve helispots were constructed during the season, most of them on the Bonners Ferry District. A total of 58 helispots for aerial spraying have now been constructed.

Antibiotic effective evaluations continued to be an important activity throughout the working season. A total of 19 new line plots were established, and 33 line plots in previously treated and control check areas were evaluated. The use of Swiss tree grippers for climbing trees greatly speeded up evaluation work in aerial spray areas.

Five artificial inoculation plots, four in basal stem treatment areas and one in an untreated area, were established. These will be evaluated in the future for treatment immunization effects.

Because of weather conditions very little project time was lost to fire suppression, but because of an unusual amount of rain, a considerable number of days were spent on projects other than antibiotics treatment.

Insect and disease control workers establishing an artificial inoculation chamber used to determine blister rust immunity of a western white pine treated with antibiotics, Kaniksu National Forest.



Left.--Inoculation technique used on seedlings in the field. Sectional view of 5-quart paper paint pail inverted over seedling, Development and Improvement Branch.

A new combined Priest Lake Ranger Station and Blister Rust Control Headquarters office was completed during 1964. When additional buildings, several of which are now under construction, are completed the old Kalispel Bay Headquarters will be eliminated.

The project had one medical injury and one vehicle accident during 1964. Additional incentive for safe work was provided by the safety award program.

Larry Smith from the Nezperce National Forest replaced Dwayne Brigham, who resigned in May 1964.

KOOTENAI NATIONAL FOREST

The 1964 program consisted of two small camps of eight men each. Ribes eradication was confined to the Pete Creek unit on 300 acres of prescribed burns, of which 120 acres were planted to white pine in 1964. Hand application of antibiotics was started in Barron Creek and completed on two small blocks in Blue and Midas Creeks. A total of 590 acres were hand treated with antibiotics.

All areas treated with antibiotics were within timber sale areas from which the overstory was recently removed, leaving a stand of pole-size white pine. Treatable leave trees in the Midas Creek block were marked in advance of treatment by a timber stand improvement forester. This reduced the treatment time required almost 50 percent. All of the 90 acres treated in the Midas and Blue Creek units, and 340 of the 500 acres treated in Barron Creek, were financed with K-V Funds.

Planned accomplishments for the 1964 season were decreased only 5 percent due to use of effective man-days on fire suppression. Of the total 893 effective man-days available, 45 were used on fire control work.

Only a few antibiotic treatment effectiveness evaluations were made in 1964 as all previous work was evaluated during 1963. Forty man-days were spent establishing permanent check trees in the Spar Lake and Yaak Face units for future study. Cankers in these 60- to 80-year-old pole stands range from 15 to 80 feet from the ground. A Swiss tree gripper was used for climbing.

The project had another effective safety program without any reportable accidents. With continued stress on safety, the operation completed its 13th consecutive year without a lost-time accident.

ST. JOE NATIONAL FOREST AND POTLATCH TIMBER PROTECTIVE ASSOCIATION

There were 120 workers employed on blister rust control work during the 1964 field season. One 30-man camp was located on Hume Creek near Emida. This unit used the antibiotic, Acti-dione, to hand treat white pine on 1,880 acres of Federal land in the West Fork Charlie Creek drainage. Another 30-man antibiotic treatment camp was stationed at Feather Creek, near Bovill, Idaho. This unit hand treated 3,090 acres of Federal, 1,740 acres of State, and 70 acres of private white pine in Moose, Purdue, and West Fork Potlatch drainages.

A 30-man State and private camp was stationed on the East Fork Potlatch Creek near the mouth of Bob's Creek. This camp eradicated ribes from 1,630 acres of State and private land near Badger Meadows and Mallory Creek. The ribes eradication work was necessary to protect the white pine reproduction from blister rust until the stand becomes large enough (at least 10 years of age) for effective antibiotic treatment.

Helicopters were used to apply the antibiotic, Phytoactin, on 10,240 acres of Federal, 3,740 acres of State, and 2,810 acres of private white pine stands during the spring and fall spray programs. Two helicopters applied Phytoactin to selected white pine areas in Little Sand, Big Creek, Feather-Porcupine, West Fork Potlatch, Moose Creek, Nat Brown-Purdue, Breakfast, Twin Creek, and Clarkia units.

An aerial spray unit treated 2,040 acres of high value pole-sized white pine on private lands near Clarkia, Idaho, during June. This project was financed with $10,000 received from the State of Idaho's special Pest Control Forest Management Fund for the first time and $10,000 matching Federal Funds.

During September, two helicopters applied Phytoactin to 1,200 acres of State-owned mature white pine on Breakfast Creek near the mouth of the Floodwood drainage. Blister rust damage is less severe in this stand than in most of the mature white pine areas in the Little North Fork Clearwater drainage. Antibiotic treatment of this 120-year-old stand is expected to control most of the present blister rust infection and should also provide some immunity against reinfection.

A 6-man canker evaluation crew established 15 check strips on areas treated with antibiotics during the 1964 field season. The evaluation crew systematically marked and recorded canker margins and infection status on 716 selected study trees. They also examined 1,160 cankers which previously had been treated with antibiotics by hand or aerial spray methods.

White pine was planted on 172 acres of Federal land during the spring of 1964 in the following drainages: Willow Creek, 45 acres; Ramskull Creek, 22 acres; Avon Creek, 35 acres; and Burnt Creek, 70 acres.

All of the plantations are within or adjacent to a presently approved blister rust control unit where ribes eradication work has been accomplished. Approximately 340 acres of Federal land will be planted to white pine during the spring of 1965. The plantations will be located in Ramskull Creek (270 acres) and Fisher Creek (70 acres). Ribes eradication work will be coordinated with the planting program to protect the plantations from blister rust until the stands are large enough for antibiotic control.

A 2-man survey team sampled several white pine stands during the summer to determine if ribes are reoccurring in areas which have been placed in a maintenance status. The crew examined 1,047 chains of status check strip and found 7 ribes with 98 feet of ribes live stem. This survey indicates that the ribes condition in the maintenance areas checked has been practically static for the past several years:

Area	Chains of check strip	Number of ribes	Feet of live stem
West Fork Charlie Creek	244	3	7
Bull Run Creek	243	2	38
Shattuck-Squaw Creek	240	1	4
Moose Creek	320	1	49
Total	1,047	7	98

To date, antibiotics have been applied to 122,770 acres of white pine stands on the St. Joe National Forest and adjacent cooperative State and private lands. There are 73,580 acres of white pine suitable for antibiotic treatment remaining to be initially sprayed.

Mortality is occurring in the mature white pine stands in the Upper St. Joe and Little North Fork Clearwater drainages. Heaviest losses are in Gold, Tumbledown, Quartz, Eagle, and Montana Creeks. Damage is due to both blister rust infection and mountain pine beetle attacks. Approximately 7 percent of the mature white pine was killed during 1964--3 percent from blister rust infection and 4 percent from beetle infestation. Expected losses in 1965 will be slightly higher due to a predicted increase in insect attacks. Blister rust infection is too far advanced in the mature white pine in these drainages for effective control using antibiotics. Dead and dying white pine is currently being removed in the Gold and Quartz drainages where there are active timber sales. Roads and sales are rapidly being developed in other mature stands where heaviest white pine losses are occurring.

Canker evaluator using Swiss tree grippers to examine and mark a blister rust canker on a mature white pine study tree, St. Joe National Forest.

The cool and damp weather conditions during the summer work period resulted in only 10 man-days spent on fire suppression work by blister rust control workers. A total of 140 man-days was used on all phases of fire control activities including training, standby, and suppression.

A large warehouse was completed this fall at the Clarkia Ranger Station for the blister rust control project. The transfer of equipment and supplies from the old Rutledge Lumber Company headquarters to the new warehouse will be completed during 1965.

All blister rust control project safety plans again stressed the responsibility of the individual for observing safe working practices. All units operated during 1964 without a chargeable injury. Camp overhead gave first-aid treatment to 26 minor injuries during the work season. Six of the cases were a result of minor allergic reactions to antibiotic solutions. Immediate treatment of all minor injuries by qualified camp overhead was very effective in preventing them from becoming chargeable medical cases. One minor vehicle accident involving a project 1/2-ton pickup and a private vehicle occurred during the heavy snow period in January 1964.

NATIONAL PARK SERVICE

MIDWEST REGION

The 1964 program was conducted as provided by the Lea Act and the 1961 agreement between the U.S. Departments of Interior and Agriculture. The National Park Service has complete responsibility for planning, operational activities, and coordination between Glacier, Yellowstone, and Rocky Mountain National Parks. The U.S. Forest Service furnished interagency leadership and gave assistance in accordance with the agreement between the two agencies.

Personnel Participating

Glacier	Charles A. Budge, Supervisory Park Ranger in Charge
Yellowstone	Marion W. Myers, Park Forester in Charge John N. Reeves, Forestry Technician, Project Supervisor
Rocky Mountain	Robert K. Weldon, Park Forester in Charge
Regional Program	John C. Gynn, Forester (TM) in Charge

U.S. Forest Service
Northern Region

David A. Graham, Section Head, White Pine Blister Rust Control
Virgil D. Moss, Chief, Methods Development and Improvement Branch, antibiotic investigations
Donald H. Brown, Pathologist, antibiotic investigations

Glacier National Park

The June flood of the Flathead River and continued inclement weather throughout the season, prevented accomplishment of all 1964 objectives. Initial basal stem antibiotic work was not completed in the Coal Creek unit because floods isolated the area until late summer. Work plans were necessarily changed to include retreatment in several more accessible areas. Abnormal summer rains also retarded antibiotic work progress.

Accomplishments included 13,500 immature western white pine trees on 150 acres initially treated, and 57,900 immature trees on 1,730 acres which were retreated. Phytoactin L-440 at 200 parts per million, in a No. 1 fuel oil with surfactant formulation was applied with backpack hand operated pressure sprayers. The scarification, basal stem direct canker method of application, was used. All 1964 work was done west of the Continental Divide. No ribes eradication work was done during 1964.

Random inspections indicate that new infection has greatly diminished in the western white pine control units since being treated with antibiotics.

Yellowstone National Park

Ribes were eradicated from more acres in 1964 than during any previous year. All 1964 objectives were achieved with initial ribes eradication on 17,110 acres requiring only 3,300 man-days or .19 man-day per acre. An unusually large amount of this--10,280 acres--was classified into the maintenance category after the single working. Rework and maintenance control work on 750 additional acres required 330 man-days or .44 man-day per acre. These were mostly areas of originally heavy ribes concentrations in stream zones and roadsides where disturbances have caused unusual ribes seed germination.

The 32 white pine blister rust control units were consolidated into 7 large basic control units. These consolidations, based on topography, continuity of type, ecological situations, working similarities, and the degree of potential rust hazard will simplify future recordkeeping and reports.

Rocky Mountain National Park

All ribes eradication work was confined to heavy ribes areas in the Hidden Valley unit. Dense concentrations of ribes are entwined with fallen insect-killed and blowdown trees in this area. While most ribes were eliminated by hormone sprays applied with portable power units, the work is extremely difficult and costly. The portions of the unit treated in 1963, 1964, and scheduled for 1965 will greatly reduce the rust introduction potential of the unit.

All objectives scheduled for 1964 were achieved. A total of 370 acres was initially treated by hand and chemical methods requiring 710 man-days. Three portable power sprayers and 25,100 gallons of 2,4,5-T herbicide at 3,500 p.p.m. in aqueous formulation were used. This method and solution gave excellent results on all species of ribes.

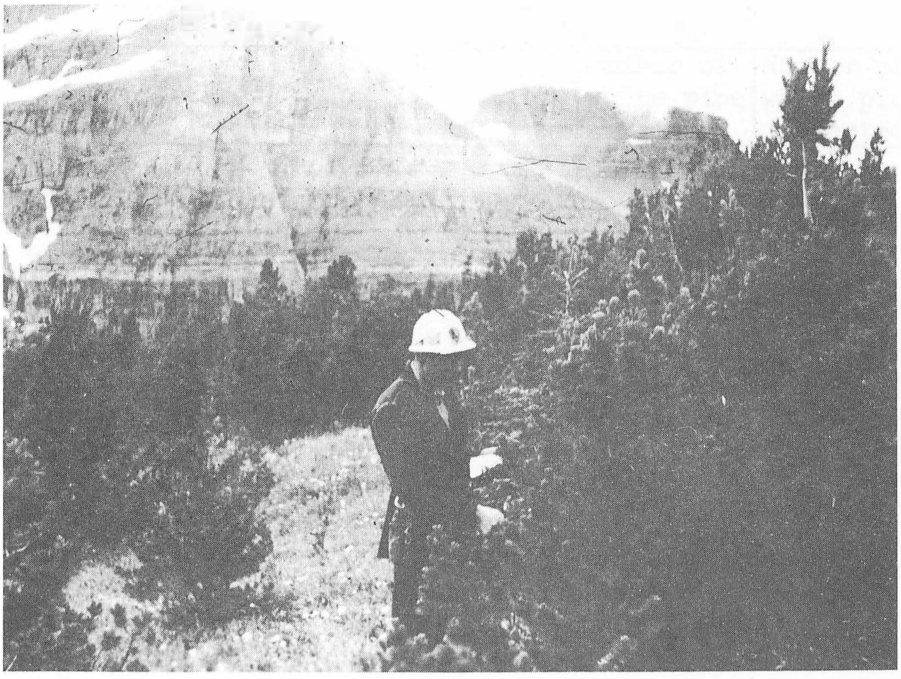
Inspections during 1964 revealed that limber pine reproduction in the Boulder Brook control unit is occurring to a greater degree than anticipated from the original surveys. Many hundreds of acres that showed only scattered seedlings in 1947, are now supporting fine stands of limber pine reproduction 8 to 12 feet in height.

Grand Teton National Park

No white pine blister rust control work was performed in 1964.

Surveys and Scouting

A systematic disease survey was made on 19,550 acres in Yellowstone National Park (see table 1). Purpose of the survey was to determine spread of the rust and intensification in known infection centers. Results definitely verified previous random inspections showing rust intensification is gaining momentum in northern portions of the Park and spreading southward. The survey located new white pine infection centers near the Indian Creek campground, lower Gardiner River, Blacktail Deer, Elk, Lost, Buffalo, Tower, lower Carnelian, Arnica, and Middle Creeks. Several other infection centers were detected in the remote, rugged northern portions by aerial (helicopter) inspection. These finds will necessitate changing previously scheduled working priorities in order to eliminate as soon as possible the potential spread of the disease. Although control units were very intensively examined, no rust was found in any treated area to date.



White pine blister rust survey in whitebark pine which is over 70 percent infected, Preston Park area, Glacier National Park.

Limber pine stand, Middle Beaver Creek, southeast of Clyde, Colorado.

Table 1.--Disease survey, Yellowstone National Park

Surveyed area	Acres	Number of white pine examined	Number of white pine infected	Percent of infection
Mammoth Control Area	1,580	1,439	--	--
Gardiner River	300	94	1	1.06
Glen Creek	2,260	2,723	667	24.50
Snow Pass	2,110	3,456	37	1.07
Indian Creek-Willow Park	5,430	5,385	4	.07
Obsidian Cliff	3,850	3,999	1	.03
Lava and Blacktail Deer Creeks	850	84	6	7.14
Buffalo, Tower, and Carnelian Creeks	1,080	7,132	327	4.58
Trout Lake, Rose, and Pebble Creeks	170	588	--	--
Lake Junction and South	800	7,614	--	--
West Shore Yellowstone Lake	70	294	--	--
Arnica Creek-West Thumb	310	3,081	1	.03
Grant Village-Lewis Lake	550	5,479	--	--
Sylvan Pass-Middle Creek	110	1,068	10	.94
Clear and Cub Creeks	170	2,564	--	--
Total	19,550	45,000	1,054	2.34

II. ANTIBIOTIC AND HERBICIDE DEVELOPMENT AND IMPROVEMENT WORK IN WHITE PINE BLISTER RUST CONTROL - 1964

Project activities and personnel assignments in the development and improvement of blister rust control methods for the calendar year 1964 were as follows:

Wayne E. Bousfield.--Development of eradicant and protectant antibiotic treatments for western white pine seedlings and reproduction less than 10 years old, and the artificial inoculations necessary to establish the degree and period of protection from new blister rust infections.

Donald H. Brown.--Development of antibiotic treatments for whitebark and limber pines, and continuation of basal stem and foliage spray tests to improve treatment methods for 10- to 20-year-old western white pine.

Lola D. Becker.--Analyzing spray solution for pH, water hardness, concentration, residue extractions for recovery and quantitative measurement of antibiotics in white pine tissues, and spray solutions.

Virgil D. Moss.--Antibiotic formulation tests to improve aerial spray methods for western white pine; continuation of herbicide tests to improve ribes eradication chemical methods; and, in cooperation with Washington State University's Department of Plant Pathology and the Intermountain Forest and Range Experiment Station, development of antibiotic residue extraction procedures.

Test results in the control of white pine blister rust with antibiotics, ribes eradication with herbicides, and a summary of new studies established during 1964 follows:

A. Western White Pine Studies

1. Seedling and young reproduction studies (trees under 10 years of age)

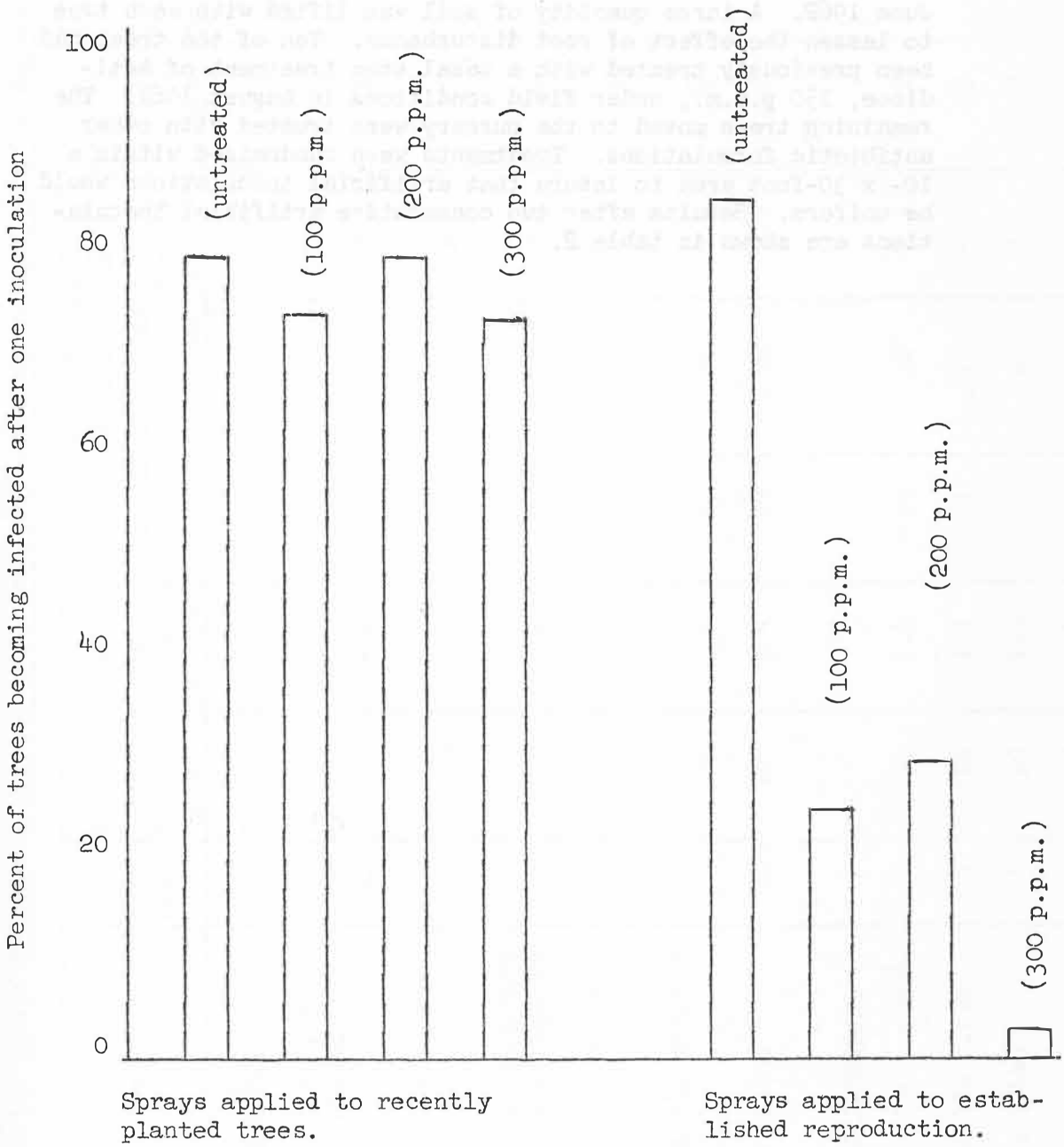
Substantial advancement has been made in the development of antibiotic treatments to protect western white pine in plantations and in natural reproduction areas from blister rust infections without ribes eradication. Repeated studies show that a single antibiotic treatment will reduce the number of blister rust infections resulting from two intensive artificial inoculations. The period and degree of protection from a single antibiotic treatment for white pine trees under natural rust conditions is still a major question to be answered. The protection period will depend upon the rapidity of antibiotic dilution and degradation resulting from rapid growth of young trees. Small seedlings will, each year, nearly double the amount of new foliage to be protected, whereas the ratio of new to old foliage is small in larger trees.

New studies will be focused on solving these questions and problems in 1965. Frequency of retreatment in relation to ribes population and rust hazard is another problem that will be studied.

a. Status of 1961 studies

Evaluation of Phytoactin foliar sprays applied in June indicates that tree physiology influences the effectiveness of foliar sprays. Phytoactin foliar sprays applied to 2-1 seedlings, 3 weeks after planting in June 1961, failed to prevent blister rust infections.

These seedlings had been lifted earlier in the spring and stored in cold storage. When these sprays were applied to well established 4- to 6-year-old natural reproduction in June 1961, the treatment reduced the number of blister rust infections following one September 1961 artificial inoculation. How tree physiology apparently alters the effectiveness of Phytoactin foliar sprays applied in June, is illustrated by the graph on the following page.


Percent of trees becoming infected after one inoculation
100
80
60
40
20
0
(untreated)
(100 p.p.m.)
(200 p.p.m.)
(300 p.p.m.)
(untreated)
(100 p.p.m.)
(200 p.p.m.)
(300 p.p.m.)
Sprays applied to recently planted trees.
Sprays applied to established reproduction.

b. Status of 1962 studies

Seventy western white pine trees, 5 to 8 years old, were lifted in the field and moved to the Coeur d'Alene Nursery in early June 1962. A large quantity of soil was lifted with each tree to lessen the effect of root disturbance. Ten of the trees had been previously treated with a basal stem treatment of Actidione, 150 p.p.m., under field conditions in August 1961. The remaining trees moved to the nursery were treated with other antibiotic formulations. Treatments were randomized within a 10- x 30-foot area to insure that artificial inoculations would be uniform. Results after two consecutive artificial inoculations are shown in table 2.

Table 2.--Antibiotic Treatments applied to 5- to 8-year-old western white pine in August 1962

Item	Tree basis	Tree infections						
		First inoculation October 1962		Second inoculation September 1963			Cumulative	
		Percent infected	Average per tree	Percent infected	Percent reinfected	Average per tree	Percent infected	Average per tree
Foliar treatment:								
Phytoactin L-318, 200 p.p.m., 20 percent oil emulsion.	10	10	4.0	50	0	2.8	60	3.0
Phytoactin L-428, dust form.	5	100	4.0	80	80	2.5	100	6.0
Cycloheximide semicarbazone, 50 p.p.m. aqueous	5	60	6.0	25	25	3.0	60	7.0
Phleomycin, 50 p.p.m. aqueous	5	40	2.5	0	0	0	40	2.5
20 percent oil emulsion control	5	20	1.0	100	100	2.4	100	2.6
Untreated checks	10	100	3.4	80	80	3.2	100	6.0
Basal stem treatment:								
Acti-dione 150 p.p.m.1/	8	50	2.2	38	38	1.3	50	3.2
Acti-dione 150 p.p.m.	7	86	1.5	71	57	2.4	100	3.5
Phytoactin L-440	5	20	1.0	80	20	5.7	80	6.0
Oil-Triton control	4	50	1.0	75	50	2.0	75	2.7

1/ Trees treated in the field in 1961.

Conclusions from two consecutive inoculations are as follows:

(1) Oil emulsion controls and untreated check trees are 100 percent infected.

(2) Foliar sprays of Phleomycin and Phytoactin L-318 are 40 and 60 percent infected, respectively.

(3) Basal stem treatment of Acti-dione applied to trees before transplanting are 50 percent infected, compared to 100 percent when the antibiotic was applied to trees after transplanting.

(4) Phytoactin L-428 applied as a dust, and Phytoactin L-440 applied as a basal stem treatment, were least effective of all treatments.

(5) Effective antibiotic treatments not only reduced the percentage of trees infected, but lowered the infection frequency on infected trees also. In most cases, untreated trees had twice as many infections as treated ones.

(6) Cycloheximide semicarbazone treatments were only 60 percent infected but had the highest infection frequency of all treatments.

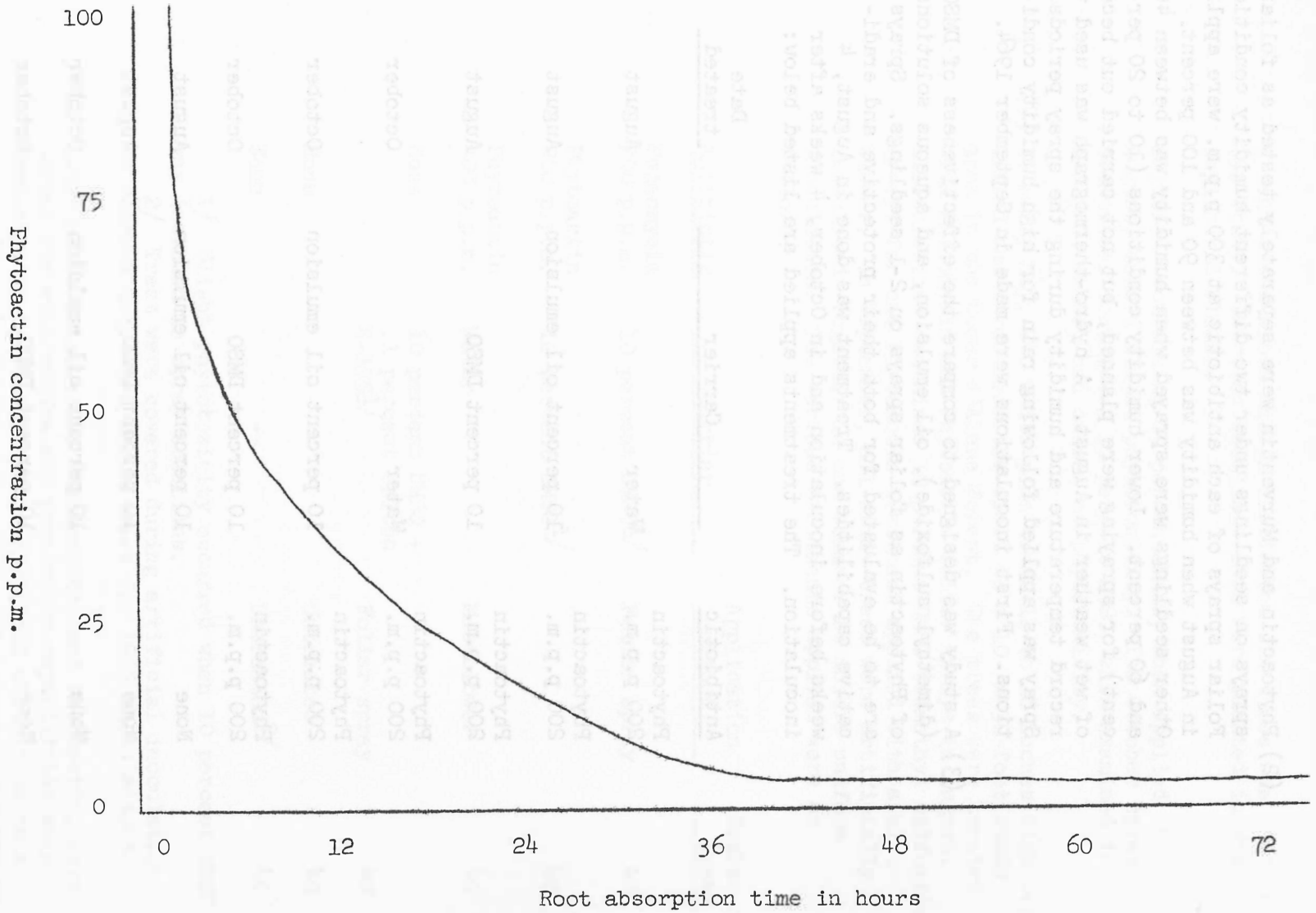
c. New studies

(1) Antibiotic absorption through tree roots was investigated this year. Two antibiotics, Phytoactin and Murventin, at 100 p.p.m. were tested in three absorption periods; 18, 36, and 72 hours. Each treatment consisted of collectively submerging the roots of 150 white pine, 2-0 seedlings in 2,200 milliliters of antibiotic solution. The roots were thoroughly washed prior to treatment. During the absorption period a compressor was used to periodically aerate the antibiotic solution. After treatment, trees were planted in their respective blocks. Solutions that remained were measured to determine volume absorbed and bioassayed to determine Phytoactin residue.

Volume of solution absorbed by 150 seedlings for different absorption periods are listed on the following page.

Treatments	Milliliters of solution absorbed - - - - - - Hours - - - - - - - 18	36	72
Phytoactin L-317, 100 p.p.m.	80	180	340
Murventin, 100 p.p.m.	50	200	220
Triton X-155 control	80	200	300
Untreated	--	--	--

Bioassay of remaining solutions showed that Phytoactin concentration substantially decreased as the absorption period increased.


100
75
50
25
0
Phytoactin concentration p.p.m.
0
12
24
36
48
60
72
Root absorption time in hours

(2) Phytoactin and Murventin were separately tested as foliar sprays on seedlings under two different humidity conditions. Foliar sprays of each antibiotic at 300 p.p.m. were applied in August when humidity was between 90 and 100 percent. Other seedlings were sprayed when humidity was between 40 and 60 percent. Lower humidity conditions (10 to 20 percent) for spraying were planned, but not carried out because of wet weather in August. A hydro-thermograph was used to record temperature and humidity during the spray periods. Spray was applied following rain for high humidity conditions. First inoculations were made in September 1964.

(3) A study was designed to compare the effectiveness of DMSO (dimethyl sulfoxide), oil emulsion, and aqueous solutions of Phytoactin as foliar sprays on 2-1 seedlings. Sprays are to be evaluated for both their protective and eradicative capabilities. Treatment was done in August, 4 weeks before inoculation and in October, 4 weeks after inoculation. The treatments applied are listed below:

Antibiotic	Carrier	Date treated
Phytoactin 200 p.p.m.	Water	August
Phytoactin 200 p.p.m.	10 percent oil emulsion	August
Phytoactin 200 p.p.m.	10 percent DMSO	August
Phytoactin 200 p.p.m.	Water	October
Phytoactin 200 p.p.m.	10 percent oil emulsion	October
Phytoactin 200 p.p.m.	10 percent DMSO	October
None	10 percent oil emulsion	August
None	10 percent DMSO	August
None	10 percent oil emulsion	October
None	10 percent DMSO	October
None	--	Untreated

A randomized block design replicated six times was used in the study. Thirteen seedlings each were planted in six replicated blocks.

Solutions containing 10 percent DMSO, when applied in August, caused slight phytotoxicity. The October spray treatments containing 10 percent DMSO, when examined in early November, had caused no phytotoxicity.

(4) In early May, 240 white pine trees 12 to 18 inches high were lifted and moved from the field to a 10- x 30-foot study area in the Coeur d'Alene Forest. The trees were treated with Phleomycin and Phytoactin foliar sprays in August. All solutions contained 10 percent DMSO (dimethyl sulfoxide) except for one Phytoactin treatment applied with a mist-blower. In September, all study trees were artificially inoculated together in one chamber to insure uniform inoculation. The various treatments applied were as follows:

Antibiotic	Carrier	Application method	Number of trees
Phleomycin 200 p.p.m.	10 percent DMSO[1/]	Foliar spray	40
Phytoactin 200 p.p.m.	10 percent DMSO[1/]		40
Phytoactin 400 p.p.m.	Water	Mistblower	40
None	10 percent DMSO + .1 percent Triton X-155[1/]	Foliar spray	40
None	--	Untreated	40
None	--	Untreated[2/]	40

1/ Slight phytotoxicity occurred when 10 percent DMSO was included in spray solutions.

2/ Trees were covered during artificial inoculation to reserve untreated check trees for 1965 inoculations.

(5) Antibiotics Phleomycin, Stendomycin, and Phytoactin, were tested for eradicative and protective capabilities when applied as a foliar spray to 8-year-old white pine in a plantation. Antibiotics were formulated as aqueous sprays with half of the treatments containing 1 percent DMSO. Sprays were applied on cool overcast days to avoid rapid

evaporation. Ten trees with one or more cankers were selected as study trees for each treatment. Five trees in each treatment were artificially inoculated in September. The remaining trees were left for natural infection. The various treatments and the number of both treated and artificially inoculated trees were as follows:

Antibiotic	Carrier	Number trees treated	Number trees inoculated
Phleomycin 200 p.p.m.	Water	10	5
Phleomycin 200 p.p.m.	1 percent DMSO	10	5
Stendomycin 200 p.p.m.	Water	10	5
Stendomycin 200 p.p.m.	1 percent DMSO	10	5
Phytoactin 200 p.p.m.	Water	10	5
Phytoactin 200 p.p.m.	1 percent DMSO	10	5
None	1 percent DMSO	10	5
None	None	0	5

2. Artificial inoculations

Portable metal frames were again used in 1964 to support the polyethylene and canvas coverings for artificial inoculations at the Coeur d'Alene Nursery. Ribes branches were placed upright over the seedlings for an inoculum source. A hydro-thermograph placed inside the chamber recorded temperature and humidity. Microslides coated with a thin layer of Vasoline served as a spore trap to determine sporidia count and germination. With the additional construction of two 10- x 30-foot chambers, 900 square feet of bed space can now be inoculated at one time.

Field inoculations on older trees were accomplished by first tying infected ribes branches, 12 to 18 inches long, to pine limbs. A large polyethylene bag was then slipped over the branch to maintain high humidity. Both ribes and pine foliage were sprayed with water before securing the bag to the branch. Only cool overcast days were selected for field inoculations. The bags were left on the branches for 3 days to insure adequate spore dissemination and germination.

Seedlings were inoculated by placing a ribes branch over the seedling and covering both pine and ribes foliage with an inverted 5-quart paper paint pail. Artificial inoculations made during 1964 are listed in table 3.

Table 3.--Artificial inoculations in 1964

Study	Date treated	Date inoculated 1964	Number trees
Coeur d'Alene Nursery			
Phytoactin-Murventin root absorption[1/]	5/64	8/27-9/1	780
Phytoactin-DMSO 20 percent oil foliar spray[1/]	8/64	9/4-11	780
5- to 8-year-old reproduction[1/]	8/62	9/17-21	65
Phytoactin-Murventin humidity[1/]	8/64	9/18-21	780
Phytoactin-Murventin tablet[1/]	5/64	9/15-18	162
Phytoactin slurry and tablet[1/]	5/63	9/22-25	50
Phytoactin-Venturicidin antibiotic combination[1/]	5/63	9/22-25	1,428
Total number of trees			4,045
Field inoculations			
Killarney Peak plots	8/63	8/27-9/1	24
South Skookum plantation[1/]	5/63, 8/64	9/9-15	150
Fourth of July plot[1/]	8/64	9/8-16	200
Brett Creek aerial spray	6/61	9/17-19	20
Independence Creek Acti-dione area	6/62	9/17-19	10
Multi-film L plot	9/62	9/17-19	3
Drexall Springs control area	Untreated	9/17-19	10
New Deal aerial spray	9/60	9/17-19	10
Goose Creek plots[1/]	7/64	9/20-23	40
Beaver Creek plantation[1/]	5/63, 6/64	9/22-25	150
Hollywood Acti-dione plots[1/]	6/61	9/22-25	20
Total number of trees			637

1/ Untreated check trees are contained in these studies.

3. Treatment of white pine planting stock in 1964

All white pine seedlings in both Savenac and Coeur d'Alene Nurseries were sprayed with Phytoactin L-318, 200 p.p.m., in September. This procedure was adopted after repeated studies had shown that spray treatments reduced the number of blister rust infections resulting

from two intensive artificial inoculations. Until more is known about the period and degree of protection obtained from this treatment, seedlings will be planted only in ribes-free areas. The purpose of seedling treatment is to increase the effectiveness of ribes eradication by reducing the number of infections resulting from both local and long distance spread of the rust. Statistical data on treatment of nursery seedlings is shown in table 4.

Table 4.--Production summary for treatment of nursery stock in 1964

Location	Age class	Thousands of trees	Tractor time (hours)	Phytoactin L-318, 200 p.p.m. used (gallons)
Savenac Nursery	1-0	3,549		
	2-0	1,904		
	1-2	267		
	2-1	733		
	2-2	153		
Subtotal		6,606	6	555
Coeur d'Alene Nursery	1-0	859		
	2-1	126		
Subtotal		985	3	165
Total		7,591	9	720

Density of the 1-0 western white pine seedlings at the Coeur d'Alene Nursery was very light and will reflect a higher gallon-per-thousand rate than at the Savenac Nursery.

The Savenac Nursery used a three-boom sprayer which reduced spray time per thousand trees over the Coeur d'Alene Nursery.

4. White pine reproduction studies

a. Status of 1962 studies

White pine reproduction, 5 to 10 years old, was treated with oil base solutions of Phytoactin L-439 and L-440 as a foliar drench in July 1962. Each study tree at the time of treatment had at least one damaging branch or incipient stem canker. Twenty trees each were treated with the two antibiotics. All foliage was wet with spray. An additional 20 trees were sprayed with No. 1 stove oil alone and an equal number left untreated

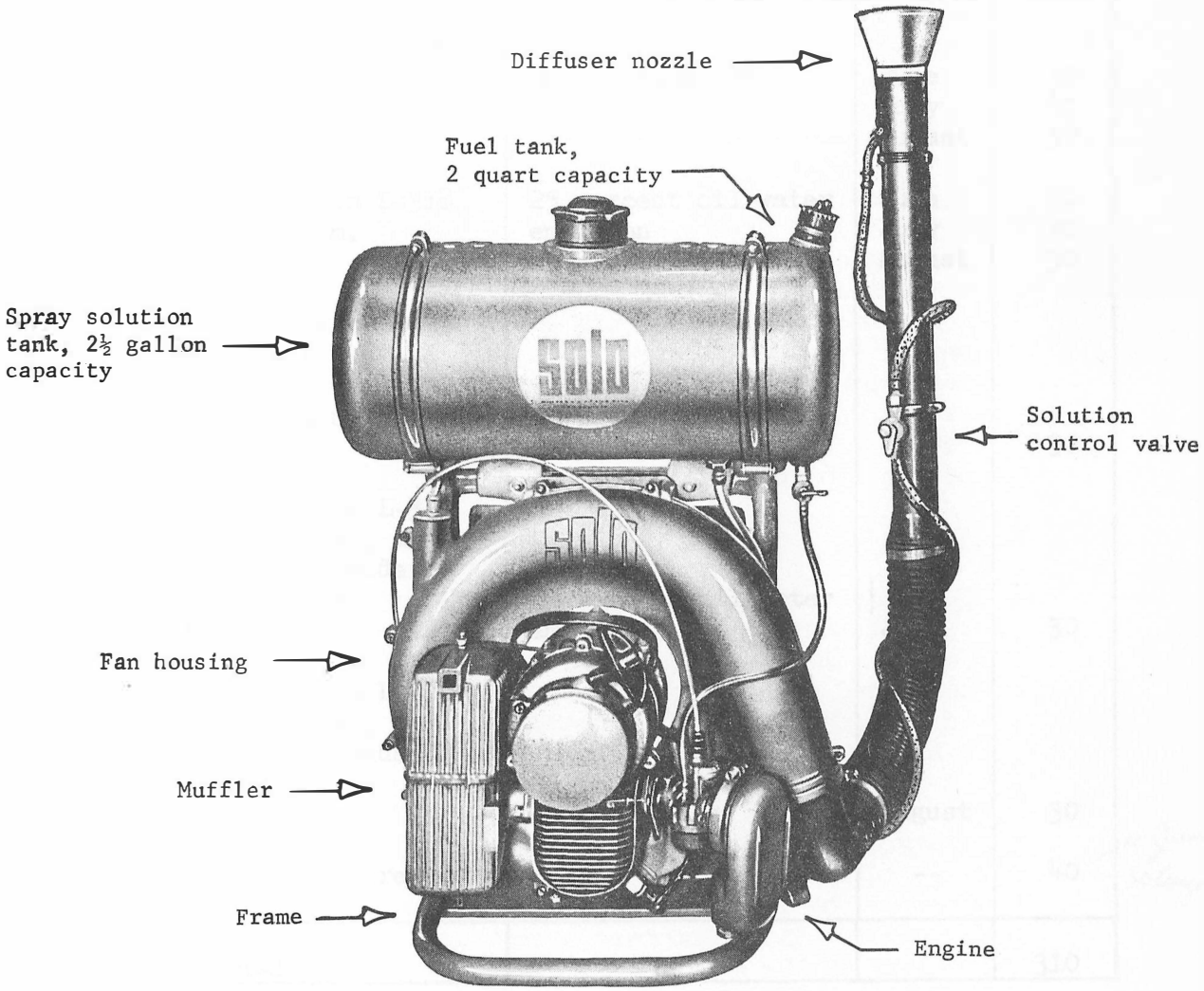
as checks. Terminal growth was damaged by all sprays when trees were examined in 1963. Tree mortality from the treatments was inconsequential. Damage could be reduced by not spraying terminal growth. Results to date are as follows:

Antibiotic formulation	Percent of infections controlled Year examined 1963	1964
Phytoactin L-439, 200 p.p.m.	25	8
Phytoactin L-440, 200 p.p.m.	22	26
Oil (alone) control	13	23
Untreated check	4	0

b. Mistblower treatments - Clearwater National Forest

The application of antibiotic solutions to western white pine 10 years and older with a backpack mistblower, first used in 1963, was continued in 1964. A new series of tests covering different tree growth stages was designed and periodically established during the field season using a backpack mistblower. One type of backpack mistblower is illustrated on the following page (fig. 1). Both disease eradication and protection will be evaluated in these tests as in the 1963 study. The various treatments are shown in table 5.

A BACKPACK MISTBLOWER
SHOWING PRINCIPLE PARTS



OPERATIONAL DATA FOR SOLO PORT MODEL 60 MISTBLOWER

Engine: 3.6 cu. in., 2 cycle, 3 HP at 6000 RPM. Air cooled from vent in fan housing.
Air volume: 275 CFM @ 210 MPH.
Air circulation: Dual purpose fan fitted on engine shaft blows air through flexible hose and rigid tube where spray solution is injected into airstream.

Assembly: Plastic and metal parts attached to tubular steel frame with rubber cushioned engine mounts and foam rubber back cushion.
Weight: 27 lbs., empty.

Figure 1

Table 5.--Mistblower applications of antibiotic solutions to western white pine 10 years and older, Brown's Creek, Clearwater National Forest

Treatment	Carrier	Month	Trees
Phytoactin L-489 400 p.p.m.	No. 1 stove oil	June	30
		July	30
		August	30
Phytoactin L-318 400 p.p.m.	25 percent oil-water emulsion	June	30
		July	30
		August	30
Phytoactin L-318 250 p.p.m., and cycloheximide BR 150 p.p.m.	25 percent oil-water emulsion	June	30
Phytoactin L-318 300 p.p.m., and cycloheximide BR 100 p.p.m.	25 percent oil-water emulsion	July	30
Phytoactin L-318 350 p.p.m., and cycloheximide BR 50 p.p.m.	25 percent oil-water emulsion	August	30
Checks (untreated)	--	--	40
Total			310

10 June
30 August

A new approach to foliar sprays using a Phytoactin-cycloheximide mixture was initiated in this study. This exploratory technique is being employed in an attempt to shorten the apparent time lag between solution application and significant cessation of normal infection activity. A time gap, or delay, becomes critical when lethal infections with rapidly advancing margins on pine reproduction are involved. A search is underway to locate a chemical compound that will shorten this critical time interval. The material must be (a) compatible with Phytoactin, (b) systemic at moderately high levels, and (c) nontoxic to white pine at concentrations that are fungistatic to the blister rust fungus for at least 1 year. Cycloheximide used in the 1964 tests met all these requirements but for phytotoxicity. Except for current

year needles, defoliation occurred in all the antibiotic mixtures within 4 weeks after spray application. In contrast, stove oil solutions of Phytoactin were not phytotoxic to the foliage even when applied during flush growth. The concentration of cycloheximide was reduced during each succeeding treatment to find a tolerable phytotoxicity level. This level was not achieved even at 50 p.p.m. Growth hormones and fungicides, including antibiotics that have shown promise on agricultural crops and appear pertinent to the objectives of this study, will be tested as foliar sprays in 1965.

Phytoactin foliar treatments applied with a mistblower in October 1963 were examined in October 1964. These treatments did not appear to alter normal disease symptoms. In some instances, the rust had advanced so rapidly that half the circumference of the stem was encircled by the rust mycelium in 1 year. This striking evidence further emphasizes the need for developing a treatment capable of inducing a rapid suppression of disease symptoms and cessation of marginal advancement. Periodic examinations will be made to determine the efficacy of the 1963 treatments.

c. Status of basal stem study

In October 1963, a basal stem study involving different antibiotics and diluents was established in the Clearwater National Forest. The trees selected were from 10 to 25 years of age and possessed both branch and stem infections. The solutions were mixed either in No. 1 stove oil or light cycle oil and applied with a backpack pressure sprayer. Phytoactin L-440, 400 p.p.m., in No. 1 stove oil applied as a foliar spray was included in the study. The different treatments and current status of the study are indicated in table 6.

Four of the five cankers shown as arrested were scarified around the infection margin just prior to treatment. Only six cankers in the entire series of treatments developed aecia in May 1964, while a majority of the cankers exhibited numerous pycnial scars in October 1964, 1 year after treatment. There was a decided decrease in superficial evidence of Tuberculina maxima for all treatments except the oil foliar. This was as expected since less than 1 year had elapsed between treatment and observations.

Periodic examinations will be made on the entire test series to study the effects of treatment on infection activity.

Table 6.--Foliar and basal stem treatment of western white pine reproduction, Brown's Creek, Clearwater National Forest

Treatment[1]	Trees	Infection status[2]				Cankers parasitized by T. maxima			
		Active		Arrested		Before treatment		After treatment	
		Number	Percent	Number	Percent	Number	Percent	Number	Percent
No. 1 stove oil only	10	16	100	0	0	6	38	5	31
Phytoactin L-440 200 p.p.m., in No. 1 stove oil	9	11	79	3	21	9	64	5	36
Murventin (Venturicidin), 200 p.p.m., in No. 1 stove oil	10	23	100	0	0	5	22	3	13
Phytoactin L-440 200 p.p.m., in light cycle oil	11	14	87	2	13	13	81	9	56
Phytoactin L-440 400 p.p.m., in No. 1 stove oil, foliar	11	25	100	0	0	6	25	17	68

1/ The first five trees in basal stem treatments, including the oil (only) control, were scarified.

2/ Arrested status indicates all normal disease symptoms (chlorosis, sporulation, etc.), are absent while positive evidence of disease eradication (i.e., callusing) is not yet apparent.

d. Status of 1960 aerial application tests

(1) Fixed-wing plane (Ford Tri-Motor) plot studies established May 27 and 28, 1960, were terminated after five growing seasons and evaluation of treatment results in 1964. The antibiotic, Phytoactin, was applied by fixed-wing plane to five 80-acre plots naturally stocked with 30- to 40-year-old western white pine in the St. Joe National Forest. Four plots, numbers 30 to 33, are adjacently located in the Moose Creek drainage. Rain fell intermittently, May 27, in spraying plots 30 and 31. Weather was partly cloudy to clear, May 28, in spraying plots 32 and 33. The contrast in results between the 2 days of variable weather in applying the same Phytoactin formulation, L-318, to the four 80-acre plots is shown in table 7.

Table 7.--Result variation due to variable weather

Plot No.	Acres	Spray date	Weather	Phytoactin L-318 spray			Percent tree recovery
				P.p.m.	Carrier	Gallons per acre	
30	80	5/27	Rain	200	20 percent oil	5	0
31	80	5/27	Rain	200	20 percent oil	10	1
32	80	5/28	Clear	400	20 percent oil	5	45
33	80	5/28	Clear	200	10 percent oil	5	43
35	20	--	--	- - -	Untreated - - -	0	3

(2) Phytoactin aerial plots sprayed by helicopter in 1959 and 1960 were again examined in 1964. Results were not significantly different from 1963. Infections previously classified dead continued to add callus tissue. Infections previously classified live from small discoloration spots continued to enlarge whether or not parasitized by Tuberculina maxima. Usually discoloration spots begin growth enlargement the fourth year after aerial spraying. Aerial retreatment should not be scheduled earlier than the fourth or fifth year after spraying.

Stem cankers on 300 trees selected at random in these treated plots were examined to establish the year of callus tissue origin. Several of the trees were felled and transverse sections cut by chain saw through the canker face. Cankers on other trees were examined from callus tissue borings. The borings were centered through callus tissue now overlapping the canker face. Callus tissue origin of the 300-tree sample was as follows: 263 cankers (88 percent) began to callus 1 year after spraying and 37 cankers (12 percent) began to callus 2 years after spraying.

Left.--A 1943 western white pine plantation. Arrow identifies the internode year, 1961, in which the tree was sprayed with Phytoactin by helicopter. Infection had entered bole at 1960 whorl, Coeur d'Alene National Forest.

Right.--Same tree October 1964, showing the callusing stem canker, that girdled almost half the bole circumference at the 1960 whorl. Infection occurred on the branch that has been cut.

e. New aerial tests

Phytoactin spray solution at 1 gallon per acre was applied by helicopter to three 40-acre test plots, June 19 and 20, 1964, Coeur d'Alene National Forest. A fourth check plot was not sprayed. The test area is stocked with 20- to 40-year-old natural reproduction. Phytoactin formulation types applied to the three plots are shown in table 8.

Table 8.--Phytoactin formulations

Plot No.	Acres	Phytoactin formulation		Per acre	
		No.	Carrier	Grams	Gallons
1	40	L-318	Water-50 percent oil	7.5	1
2	40	L-488	oil	7.5	1
3	40	L-489	oil	7.5	1
4	40	Check	None	0	0

In an effort to increase the absorption of Phytoactin, DMSO was added to the standard formulation and applied at 7 gallons spray solution per acre by helicopter to two 125-acre test plots, September 1964, St. Joe National Forest. The test area is naturally stocked with 20- to 40-year-old western white pine. Phytoactin formulations applied to the test plots are shown in table 9.

Table 9.--Test series using DMSO additive

Plot No.	Acres	Phytoactin formulation		DMSO	Per acre	
		No.	Carrier	Percent	Grams	Gallons
1	125	L-318	Water	1	7.5	7
2	125	L-318	Water-10 percent oil	1	7.5	7
3	125	L-318	Water-20 percent oil	0	7.5	7
4	20	Check	None	0	0	0

f. New studies - foliar penetrants

A study designed to investigate the possible advantages and effects of organic solvents as adjuvants in antibiotic spray solutions was established during 1964 on the Coeur d'Alene National Forest. Two organic solvents, DMSO and Dowanol (methyl cellosolve) were incorporated in Phytoactin solutions to determine their effect on absorption and penetration of the antibiotic. An increase in absorption and distribution efficiency would improve on disease eradication and protection by Phytoactin.

A standard 20 percent No. 1 stove oil-water emulsion Phytoactin L-318, 200 p.p.m., with and without a solvent and untreated checks were the three basic treatments in the study.

The oil-water emulsions were applied to both reproduction size pine and the lower crowns of mature trees with a backpack mist-blower. Foliage samples collected from all these treatments at regular intervals will be analyzed in the laboratory for the presence of Phytoactin. Because the primary objective of the study is to evaluate antibiotic penetration and internal concentration levels by bioassay techniques, no disease control observations are planned. The various treatments are shown in table 10.

Table 10.--Organic solvents as foliar penetrants on reproduction and mature western white pine in the Coeur d'Alene National Forest

Treatment[1/]	Organic solvent	Age class	Number trees sprayed
Phytoactin L-318 200 p.p.m.	--	Reproduction	2
Phytoactin L-318 200 p.p.m.	DMSO, 2 percent	Reproduction	2
Phytoactin L-318 200 p.p.m.	Methyl cellosolve 2 percent	Reproduction	2
Check (untreated)	--	Reproduction	1
Phytoactin L-318 200 p.p.m.	--	Mature	2
Phytoactin L-318 200 p.p.m.	DMSO, 2 percent	Mature	2
Phytoactin L-318 200 p.p.m.	Methyl cellosolve 2 percent	Mature	2
Check (untreated)	--	Mature	1

1/ All treatments were 20 percent oil-water emulsions containing 0.5 percent "Tween 20."

B. Whitebark and Limber Pine Studies - Glacier National Park and Blackfeet Indian Reservation

1. Basal stem and foliar tests for 1959-1962

Most of the test plots on whitebark and limber pines established between 1959 and 1962 on the east side of the Continental Divide in or near Glacier National Park were carefully examined in June 1964.

a. Basal stem

Basal stem tests were designed primarily to kill infections by direct application of cycloheximide or Phytoactin solutions. Data describing external evidence of canker activity was recorded for each tree. Out of a total of 750 infections examined, only 13 displayed evidence of successful disease control. Two stem infections that were successfully killed by direct application of cycloheximide are illustrated in figure 2. A majority of all stem cankers directly treated showed greatly reduced activity with very light sporulation and a minimum amount of chlorosis in the bark. If some type of infection incision had been used, a greater number of these infections might have been killed. A majority of the branches present in the spray zone died regardless of whether or not they were infected. As a result it was difficult to evaluate direct fungicidal action on branch infections.

b. Foliar

Three test plots, each at a different location, treated with Phytoactin foliar sprays, were examined in June 1964. Out of 200 cankers examined for fungicidal effect, only 4 showed evidence of successful disease control. A typical stem infection showing cessation of normal activity is illustrated in figure 3. No reliable consistency in disease control was found because trees with callusing cankers also had active infections. New tests were established in 1963 to duplicate and improve on these initial results.

An evaluation of the results for both basal stem and foliar treatments indicated that a successful treatment for whitebark and limber pine has not yet been found.

Figure 2.--Basal stem treatments on whitebark pine with cycloheximide, 150 p.p.m., applied July 1960. Callus tissue formation is evident around edge of dead infection area on both trees.

Figure 3.--Callusing canker on limber pine treated with Phytoactin L-318, 200 p.p.m., August 1959. Dead branch in center of canker served as entry for infection into stem.

2. Basal stem, foliar, and stem injection tests for 1963

a. Disease control and translocation studies

The few encouraging results found in the older tests formed the basis for a new series of basal stem and foliar tests on whitebark pine. Only a limited number of observations were made in 1964 on these recently applied treatments. A spot check through some of the basal stem tests revealed that scarification or canker margin incisions alone, drastically interfered with aecia formation the following spring. Other observations showed oil foliar sprays caused varying amounts of phytotoxicity to new growth when applied by backpack pressure sprayers. The oil foliar treatments definitely suppressed normal infection activity which was not evident in the oil-water emulsion foliar sprays.

The insertion of concentrates of different antibiotics in the cambial region of whitebark, by incisions made through the bark, showed evidence 1 year later that translocation of at least one of the antibiotics did occur. The death of bark tissue caused by the high concentration of cycloheximide was accepted as evidence of translocation in the tree (fig. 4). This phytotoxicity was absent on the untreated check trees. The translocation of cycloheximide in western white pine following injection in the tree using similar methods was reported in the 1961 Region 1 Blister Rust Control Annual Report. In contrast, the translocation of Phytoactin or Murventin as indicated by bark necrosis or phytotoxicity was not apparent after the same period of time. Very little difference in external appearance was found between Phytoactin, Murventin, and untreated check trees, all of which looked similar to the tree shown in figure 5. A thorough examination of these tests and the other 1963 studies is planned for 1965.

b. Bioassay results

Branch and foliage tissues collected in August 1964 from trees sprayed in August 1963 with Phytoactin solutions, were analyzed in the laboratory. Only qualitative results could be determined at this time using extraction and bioassay procedures still being revised and improved. However, these preliminary results showed that Phytoactin is absorbed by whitebark pine and is detectable in extractions made from branch and foliage samples collected 1 year after treatment.

A greater degree of Phytoactin activity was detected in tissue extracts obtained from trees sprayed with a 400 p.p.m. solution than from trees sprayed with a 200 p.p.m. solution.

Figure 4.--Evidence of translocation of cycloheximide in whitebark pine. Vertical strips of dead bark are evident above and below the point of insertion as indicated by the knife point.

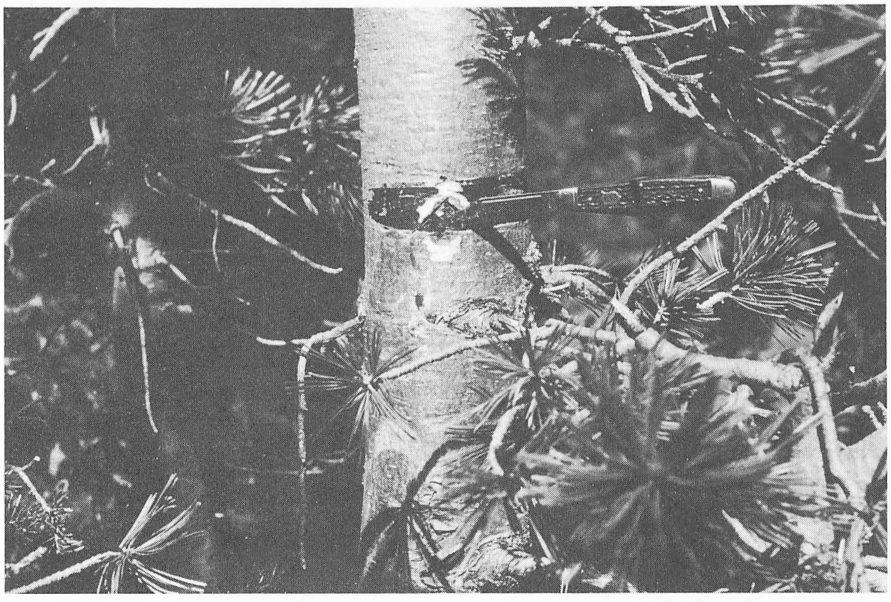


Figure 5.--An untreated check tree in the stem injection study. Tree was treated the same as the one shown in figure 4 except that no antibiotic concentrate was placed in the bark incision.

In still another analysis, tissue extracts from trees sprayed in August 1964 with Phytoactin L-318, 200 p.p.m., 2 percent DMSO, showed as much or more, antibiotic activity in the bioassays than was detected in the bioassays of the 1963 treatments. Tissue analyses will be continued on these and other treatments of whitebark pine.

3. Ground Treatments Applied in 1964

A series of basal stem and foliar treatments were established on whitebark pine at Hudson Bay Divide in the Blackfeet Indian Reservation. These elaborated on the treatments applied in 1963, on a smaller scale, using newer materials and equipment. The various treatments are described in table 11.

Table 11.--Antibiotic treatments on whitebark pine, Hudson Bay Divide, 1964

Treatment method	Carrier	Antibiotic solution	Trees	Cankers
Basal stem and direct canker (with scarification)	Scarified checks	--	6	11
	No. 1 stove oil	--	10	22
	No. 1 stove oil	Phytoactin L-439 200 p.p.m.	10	20
	No. 1 stove oil	Phytoactin L-440 200 p.p.m.	10	18
	No. 1 stove oil	Phytoactin L-440 200 p.p.m., and cycloheximide 100 p.p.m.	12	28
	No. 1 stove oil	Cycloheximide 150 p.p.m.	12	31
Mistblower foliar	Untreated	--	5	12
	Water	2 percent DMSO	5	12
	Water	Phytoactin L-318 200 p.p.m.	5	12
	Water	Phytoactin L-318 200 p.p.m., and 2 percent DMSO	5	14
	25 percent oil-water emulsion	Phytoactin L-318 200 p.p.m., and 2 percent DMSO	9	18
	25 percent oil-water emulsion	Phytoactin L-318 400 p.p.m.	10	23
	25 percent oil-water emulsion	Phytoactin L-318 300 p.p.m., and cycloheximide 100 p.p.m.	12	21

Foliar treatments were applied with a backpack mistblower and basal stem sprays with a Hudson pressure sprayer. All trees in the basal stem treatments were scarified around branch and stem canker margins. In contrast to the phytotoxicity of Phytoactin-cycloheximide foliar sprays reported for western white pine, no toxicity was apparent from this same antibiotic combination on whitebark pine foliage up to 8 weeks after application. A rapid cessation of infection activity is just as important on younger age whitebark pine as it is on western white pine. Any difference in species response to cycloheximide foliar sprays will be carefully studied.

An organic solvent, DMSO, was included in the foliar tests to study its effect on needle penetration by Phytoactin. Some type of foliar penetrant would prove useful in antibiotic treatments of whitebark and limber pine on sites where exposure to severe weather may have induced changes in needle structure, thereby lowering their foliar absorption potential.

4. Aerial application in 1964

A milestone was reached this year with the aerial treatment of whitebark pine by helicopter in the Blackfeet Indian Reservation. This "first" is another phase in the program to develop an effective antibiotic treatment for high elevational white pines.

The test blocks, 5 acres in size, were laid out near timberline in predominately whitebark pine type at approximately 6,000 feet in elevation. Sample trees selected in each block possessed branch infections with discolored margins that were either just entering the stem or were within 8 inches of the stem. Crown canopy position and crown structure in relation to spray coverage were considered in tree selection in addition to disease condition. The plots will be periodically examined to study the effects of treatment on infection activity.

The actual spray operation started on September 29 was not completed until October 4 because of inclement weather. The antibiotic spray was applied only when air temperature and wind velocity were within minimum requirements. Some of the different phases of the project are illustrated in figures 6 and 7. The various treatments applied are outlined in table 12.

The mixing equipment proved somewhat inadequate for the limited amount of available spray time. An examination of oil sensitive spray cards, randomly placed in several of the plots, indicated good spray coverage was obtained in these plots. In addition, ground observers with good overall views of the spraying operation provided another check. Careful selection of test plots and study trees, observance of proper weather conditions necessary for spraying, and evidence of good spray coverage all point to the successful establishment of the project.

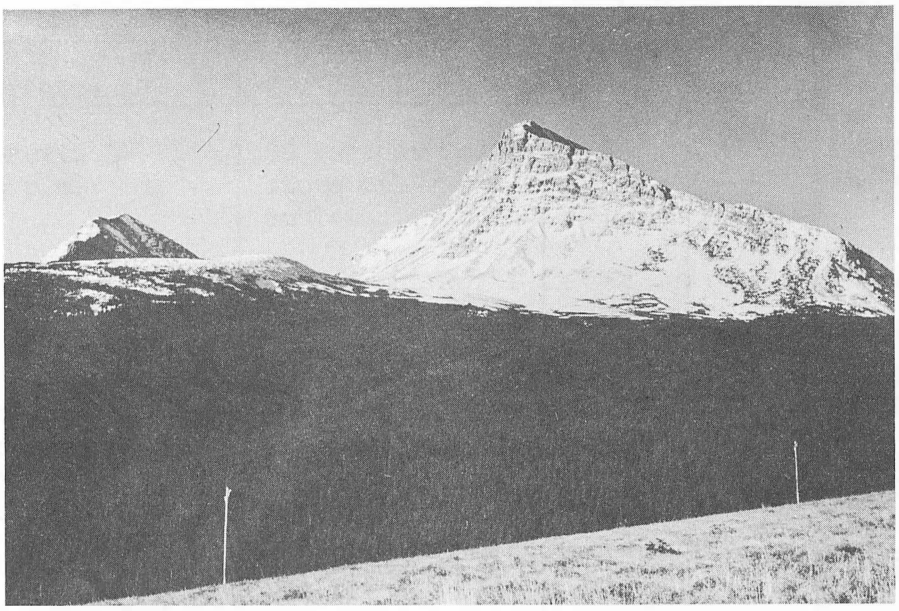


Figure 6.--View of Divide Mountain (right center) and Hudson Bay Divide aerial spray plot area.

Figure 7.--Helicopter application of a 50 percent No. 1 stove oil-water emulsion of Phytoactin at 10 gallons per acre to whitebark pine.

Table 12.--Aerial application of antibiotic solutions on whitebark pine, Blackfeet Indian Reservation, 1964

Treatment	Carrier	No. of plots	Total acres	Total trees
Phytoactin L-515 200 p.p.m.	50 percent No. 1 stove oil-water emulsion	4	20	60
Phytoactin L-318 200 p.p.m.	25 percent No. 1 stove oil-water emulsion	2	10	30
Phytoactin L-318 200 p.p.m., and cycloheximide 100 p.p.m.	25 percent No. 1 stove oil-water emulsion	2	10	31
Phytoactin L-440 200 p.p.m., and cycloheximide 50 p.p.m.	No. 1 stove oil	1	5	15
Phytoactin L-440 200 p.p.m.	No. 1 stove oil	4	20	63
Checks (untreated)	--	4	20	57
Total		17	85	256

C. Herbicide Tests on Ribes

Tordon 10K (4-amino-3,5,6-trichloropicolinic acid as the potassium salt) and Dybar (3-phenyl-1,1-dimethylurea) pellets were applied to Ribes viscosissimum and R. lacustre in June on the Coeur d'Alene Forest. One teaspoonful of pellets was placed on the ground surface around each root crown. Plants were 6 to 8 years old. In August, leaves of plants treated with Tordon were uniformly brown, whereas, leaves of plants treated with Dybar were mottled green and brown. Dybar tended to accumulate and kill leaf margins, whereas, Tordon was generally distributed in the foliage to kill all parts of a leaf simultaneously. Tordon sprays were applied by helicopter and hand in the Clearwater Forest. Test results for both pellets and sprays will be reported in 1965.

D. Cooperation

Research in the recovery of Phytoactin from white pine tissues and spray solutions was continued, cooperatively, by Washington State University, Department of Plant Pathology; P-L Biochemicals, Inc. (formerly Pabst Laboratories); and Development and Improvement Branch, U.S. Forest Service. In the calendar year 1964, accomplishments included:

1. New method developed for increased efficiency in extracting Phytoactin from treated western white pine tissues.

2. Adaptation of these procedures to extract Phytoactin from white-bark and limber pines.

3. Developed a procedure to recover Phytoactin from oil in the bioassay of basal stem solution.

4. A method to recover Phytoactin by the separation of oil and water in the bioassay of aerial spray solutions.

University, forestry, and industrial visitors to the Development and Improvement Branch Office and field plots in the calendar year 1964 included:

P-L Biochemicals, Inc. (formerly Pabst Laboratories)

Dr. Alex Sigal - Vice President and Technical Director, Microbiological and Chemical Research, Milwaukee, Wisconsin
Dr. Jack Ziffer - Director of Microbiological Research, Milwaukee, Wisconsin

The Murphy Chemical Co., Ltd.

Dr. G. L. Hey - Joint Managing Director, Wheathampstead, England

Pennsalt Chemicals Corporation

Dr. Obren Keckemet - Technical Director, Agricultural Chemicals Division, Tacoma, Washington
Dr. H. L. McNeill - Agricultural Chemicals Field Representative, Wenatchee, Washington

Washington State University

Dr. C. Gardner Shaw - Chairman, Department of Plant Pathology, Pullman, Washington
Dr. Shirl O. Graham - Associate Plant Pathologist, Department of Plant Pathology, Pullman, Washington
Alan Harvey - Research Assistant, Department of Plant Pathology, Pullman, Washington
Martin Stoner - Research Assistant, Department of Plant Pathology, Pullman, Washington

Canada Forest Service, Alberta Province

Dr. George P. Thomas - Officer-in-Charge, Forest Entomology and Pathology Laboratories, Calgary, Canada
J. A. Baranyay - In Charge, Forest Disease Surveys, Calgary, Canada

U.S. Forest Service

Warren V. Benedict - Director, Division of Forest Pest Control, Washington, D.C.
John M. Whiteside - Head, Section of Insect Control, Washington, D.C.
Dr. Keith Arnold - Director, Division of Forest Protection Research, Washington, D.C.
Dr. John R. Hansbrough - Director, Forest Disease Research, Washington, D.C.
Joseph F. Pechanec - Director, Intermountain Forest and Range Experiment Station, Ogden, Utah
Charles A. Wellner - Chief, Division of Timber Management and Forest Disease Research, Ogden, Utah.

III. DEVELOPMENT OF BLISTER RUST RESISTANT WHITE PINE - 1964

This was the fifteenth year of work in the long-range cooperative program for breeding western white pine resistant to the blister rust disease.

The 1964 bumper white pine cone crop predicted in 1963 gave adequate numbers of seeds from four test crosses on each of 107 new candidate trees. Only 4 of the 111 candidates pollinated with four test cross pollens in 1963 failed to produce adequate numbers of seeds for progeny testing. Cone and seed yield was so great that our technical staff was still extracting and pre-sowing seed on paper strips when the first snow fell. Seed sowing in the more than 825 running feet of seedbed was not completed until January 13, 1965.

The production of blister rust resistant white pine is now on a definite schedule (fig. 8), based on a Station-Region Memorandum of Understanding and implemented by annual cooperators' meetings.

Current Station progress under the various steps outlined in the chart is as follows:

Step 1.--411 canker-free trees selected, step completed.

Step 2.--316 trees test-crossed and with test-cross progenies planted in nursery, 209 of these inoculated once or more (the nursery now contains close to 1,900 running feet of 4-foot-wide nursery bed progeny tests).

Step 3.--9 to 16 low-elevation general combiners, finally or tentatively selected, 7 to 22 mid-elevation, and 3 to 9 high-elevation.

Step 4.--4 low-elevation pairs remated, 5 mid-elevation pairs remated, and 3 high-elevation pairs remated.

Step 5.--Starting in 1965 with sowings of remated pairs of general combining ability trees.

PRODUCTION OF BLISTER RUST RESISTANT WHITE PINE

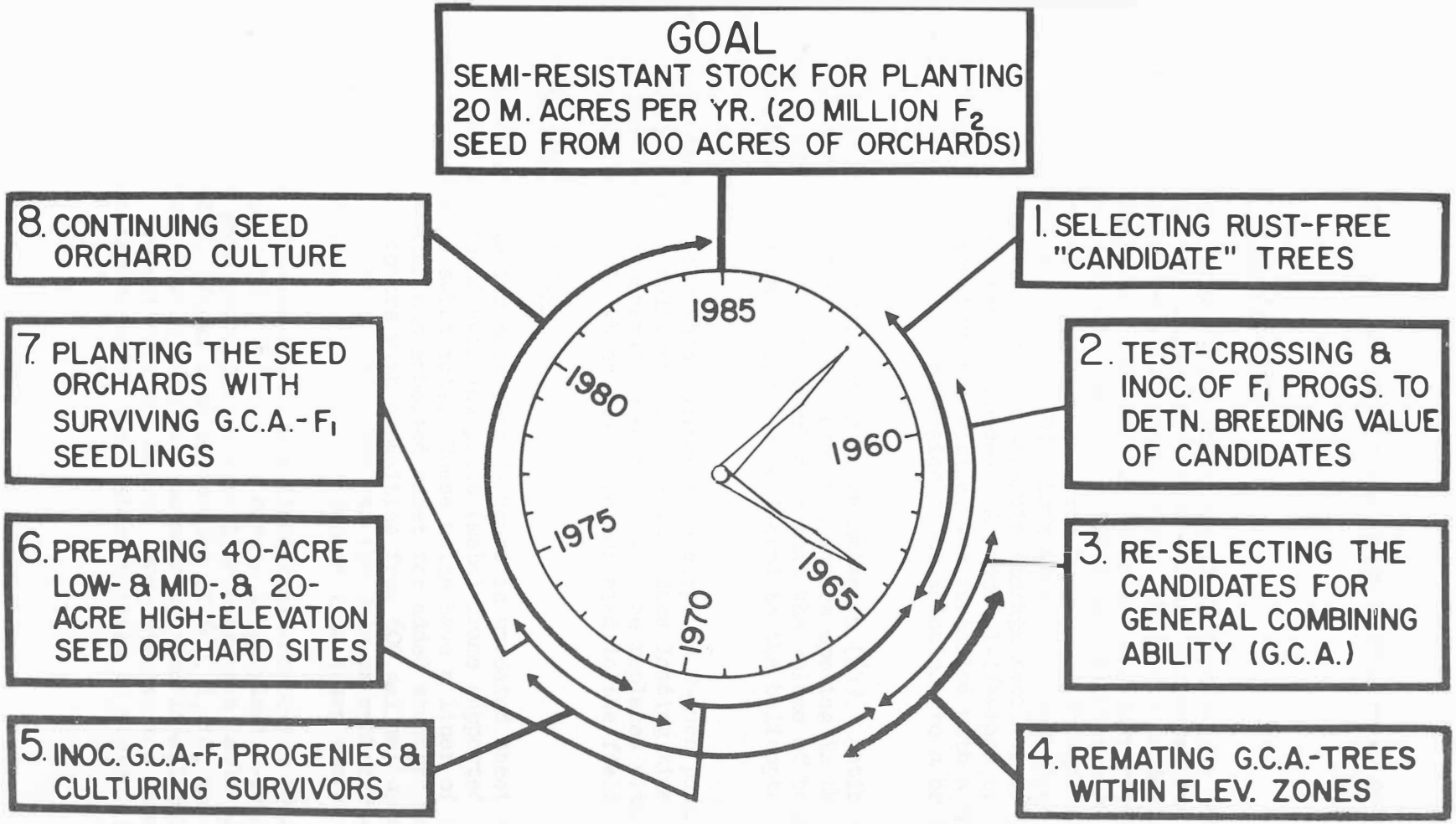

GOAL
SEMI-RESISTANT STOCK FOR PLANTING 20 M. ACRES PER YR. (20 MILLION F_2 SEED FROM 100 ACRES OF ORCHARDS)
1. SELECTING RUST-FREE "CANDIDATE" TREES
2. TEST-CROSSING & INOC. OF F_1 PROGS. TO DETN. BREEDING VALUE OF CANDIDATES
3. RE-SELECTING THE CANDIDATES FOR GENERAL COMBINING ABILITY (G.C.A.)
4. REMATING G.C.A.-TREES WITHIN ELEV. ZONES
5. INOC. G.C.A.-F_1 PROGENIES & CULTURING SURVIVORS
6. PREPARING 40-ACRE LOW- & MID-, & 20-ACRE HIGH-ELEVATION SEED ORCHARD SITES
7. PLANTING THE SEED ORCHARDS WITH SURVIVING G.C.A.-F_1 SEEDLINGS
8. CONTINUING SEED ORCHARD CULTURE
1985
1980
1960
1975
1965
1970

Figure 8

IV. MECHANICAL DEVELOPMENT AND IMPROVEMENT FOR WHITE PINE BLISTER RUST CONTROL - 1964

A. Aerial Spray Service Mixer Assembly

The mixer-service tanker for foliar power spraying, reported in the 1962 Annual Report, was modified during 1964 into a small mixer-service unit suitable for transporting on a 1-1/2-ton truck. This unit is designed for spraying small areas where the use of the larger and more expensive mixer-service units is not practical. A 1-1/4-inch tri-rotor pump (fig. 9) was installed to take raw water from one of the 250-gallon tanks and pass it through the softener (#10). Soft water produced flows either to the other 250-gallon tank or to a separate storage facility (#6, #4). This pump may be stopped when not needed. A second 1-1/4-inch tri-rotor pump which is chain-driven from the engine, was installed with a control valve for filling, mixing, or discharging final solutions to a helicopter as required.

Paddle agitation rate is regulated by a transmission (#5). Antibiotics and other additives are introduced through a square opening in the top of the mixer. The meter (#3) is plumbed so that the volume of both incoming materials and final solutions delivered to the helicopter can be recorded.

When more extensive use for this equipment develops, a 2-inch pump will be installed for filling helicopters so as to reduce loading time, and the 1 cubic foot brine regenerating softener will be replaced with a 90,000-grain resalting unit which can be regenerated in the field.

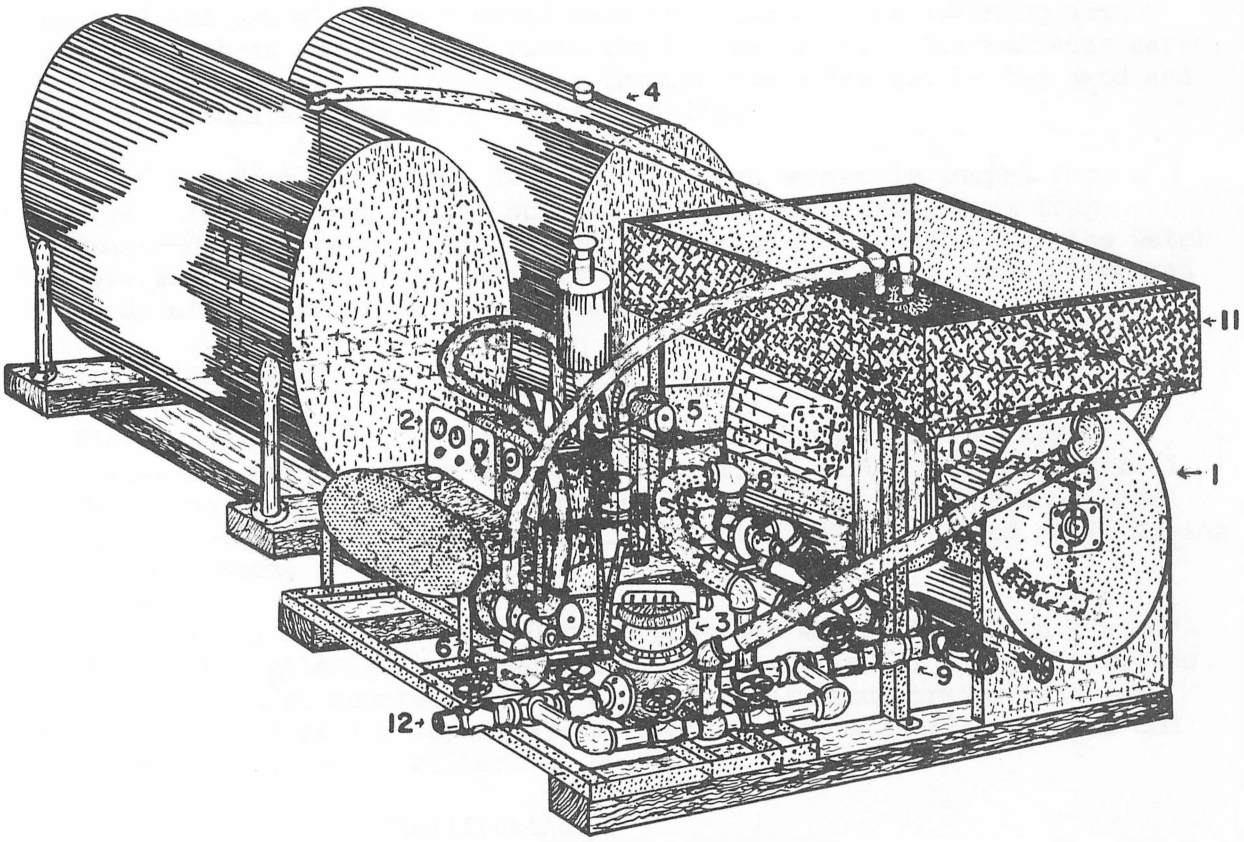
B. Soft Water Storage Facilities

Since soft water storage for more than 24 hours in uncoated sheet steel tanks is not advised; round swimming pools (metal frame supported, above ground) can be used as a substitute. These units have a liner of vinyl plastic, backed by an aluminum embossed sheet for added strength and appearance. Tanks and covers with capacities from 600 gallons upward to 14,000 gallons are available. Mats, such as the jute or rubber rug pads are needed beneath these pools to prevent damage from sharp rocks.

Heavy duty Herculite open-topped, square-lined tanks supported by a steel tube frame can also be used. These units have a tough plastic-reinforced nylon fabric liner. Waterproof canvas duck liners are available also, but are not recommended. Tanks with capacities of 600, 1,000, and 1,500 gallons are available. Covers which can be made up from 10-mil polyfilm sheeting are used to prevent dirt and debris from entering the stored water. Mats are also needed under these storage tanks to prevent rock damage.

AERIAL SPRAY SERVICE MIXING ASSEMBLY

FOR TREATABLE LOW ACREAGE PINE STANDS



PARTS IDENTIFICATION

1. 100 GALLON PADDLE MIXER
   Chain driven from the transmission
2. 2 CYLINDER GASOLINE ENGINE
   Electric start Wisconsin
3. 2" SMITH METER – CAPACITY 80 GPM
   Reset – records each batch and totals
4. 250 GALLON STORAGE TANK
   2 Tanks piped to softener and mixer
5. 2 SPEED TRANSMISSION
   High – low and neutral
6. 1½" TRI–ROTOR PUMP FOR SOFTENER
   Driven by v-belt, release lever to stop
7. 1½" TRI–ROTOR TRANSFER PUMP
   Fills - mixes - discharges to helicopter
8. OUTLET PRESSURE LINE
   Valves route fluids as desired
9. PUMP INLET LINES
   Connected to both storage and mixer tanks
10. 1 CUBIC FOOT WATER SOFTENER
    Supplies soft water
11. FILLER HOSE STORAGE COMPARTMENT
    Carries hose, nozzles, and accessories
12. OUTLET DISCHARGE HOSE COUPLING
    Connection to dischage line

Figure 9

C. Antibiotic Spraying Water Supplies

Although clean water has been an objective throughout all phases of the aerial spraying program, our equipment has not been able to consistently provide it. Filter elements have been severely damaged during backwashing by sand and gravel which entered from the inside. The spinning action cuts the fabric covering and ruins the entire filter. Diatomaceous earth, moss, clay, and sand which escapes through the holes cut by the sand and gravel contaminate the water softener units.

Most of the dirt and debris is picked up when water is pumped from a source into the nurse truck tank. A screened sand and gravel trap compartment must be provided to remove foreign materials before the water enters the truck tank. A satisfactory screened sand and gravel trap has been developed and it is now available to all units.

D. Water Softeners for Antibiotic Sprays

A Kisco Abso-Soft 240,000-grain, 8 cubic foot Dowex resin equipped softener was purchased and installed on a 2,000-gallon mixer for aerial spraying on the Coeur d'Alene National Forest. All of the Bruner Model 210C, 210,000-grain softeners installed during 1963 were used again during the 1964 season.

A Bruner Model R120-1, 120,000-grain softener was installed on a mixer unit with a similar softener purchased in the spring of 1963. These two paired softeners, mounted on each side of an aluminum trailer storage tanker of 1,700-gallon capacity, are connected to a 1-1/2-inch pump and a Jacuzzi Model FGF-15 filter.

E. Hand Tool for Canker Scarification

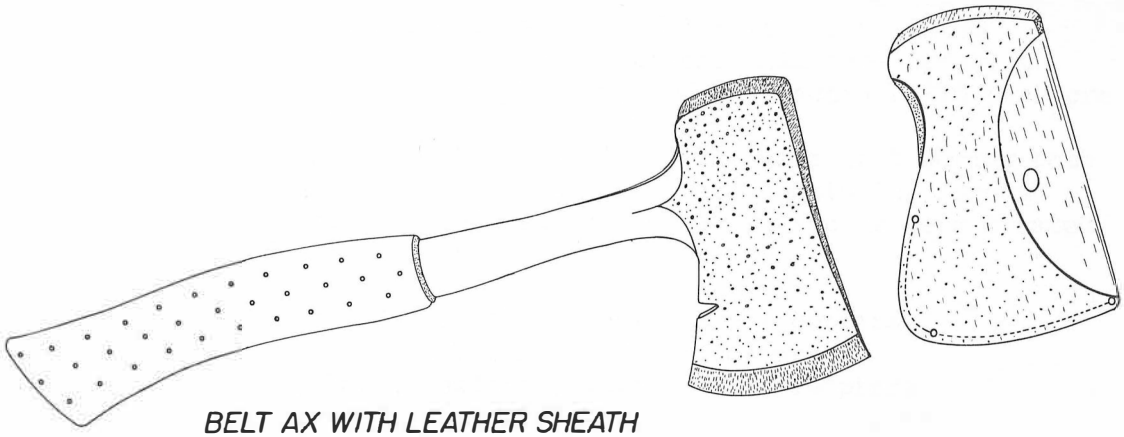
Hand tools used during 1964 for scarifying cankers included a small belt ax for use on trees with thick bark.

A spray wand with the pronged rowel replaced with a blade of 12-gage saw steel was also used satisfactorily in some areas. Tools purchased for the 1965 season will be constructed with similar 11-gage, #304 stainless steel blades (see fig. 10).

A scarifier with a small ax blade attached on the top was also used extensively in 1964 but it proved inferior as a chopping tool to either of the others.

These tools with blades attached are excellent for cankers on larger trees with heavy bark. The regular scarifier spray wand as reported in the 1963 Annual Report was used extensively in 1964. It is the best tool for small trees with thin bark.

HAND TOOLS FOR
WHITE PINE BLISTER RUST CANKER CONTROL

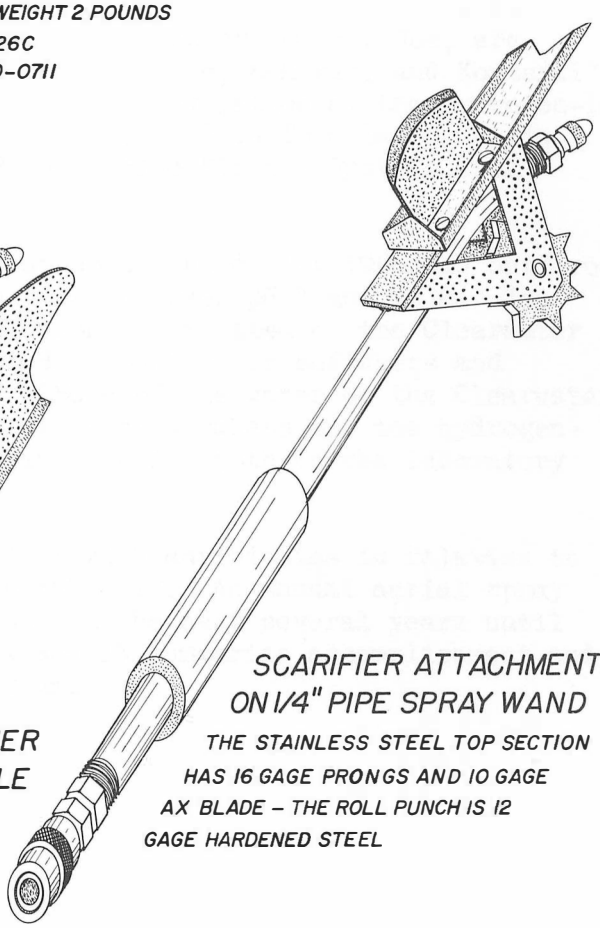


BELT AX WITH LEATHER SHEATH

STEEL HANDLE RUBBER GRIP
BLADE WIDTH 3" LENGTH 13½" WEIGHT 2 POUNDS
FED. SPEC. GGG A-926C
GSA CAT. NO. 5110-720-0711

SPRAY WAND SCARIFIER
ON 1/4" PIPE WITH NOZZLE

THE AX IS 12 GAGE SAW STEEL – STAINLESS STEEL TOP SECTION IS 16 GAGE AND REVERSIBLE



SCARIFIER ATTACHMENTS
ON 1/4" PIPE SPRAY WAND

THE STAINLESS STEEL TOP SECTION HAS 16 GAGE PRONGS AND 10 GAGE AX BLADE – THE ROLL PUNCH IS 12 GAGE HARDENED STEEL

Figure 10

V. AERIAL APPLICATION OF ANTIBIOTICS - 1964

All aerial spraying in 1964 was done with helicopters using the standard formulation of Phytoactin L-318 emulsified with Multi-film L in an 80 percent water and 20 percent No. 1 fuel oil solution. All 1964 spraying was done at the rate of 7 gallons with 7.5 grams of Phytoactin L-318 per acre.

Twelve helicopters contracted from the following firms were used during both the spring and fall spray seasons. Starting May 4 and continuing through June 30, 46,020 acres were sprayed. An additional 42,840 acres were treated during September 1 through October 10.

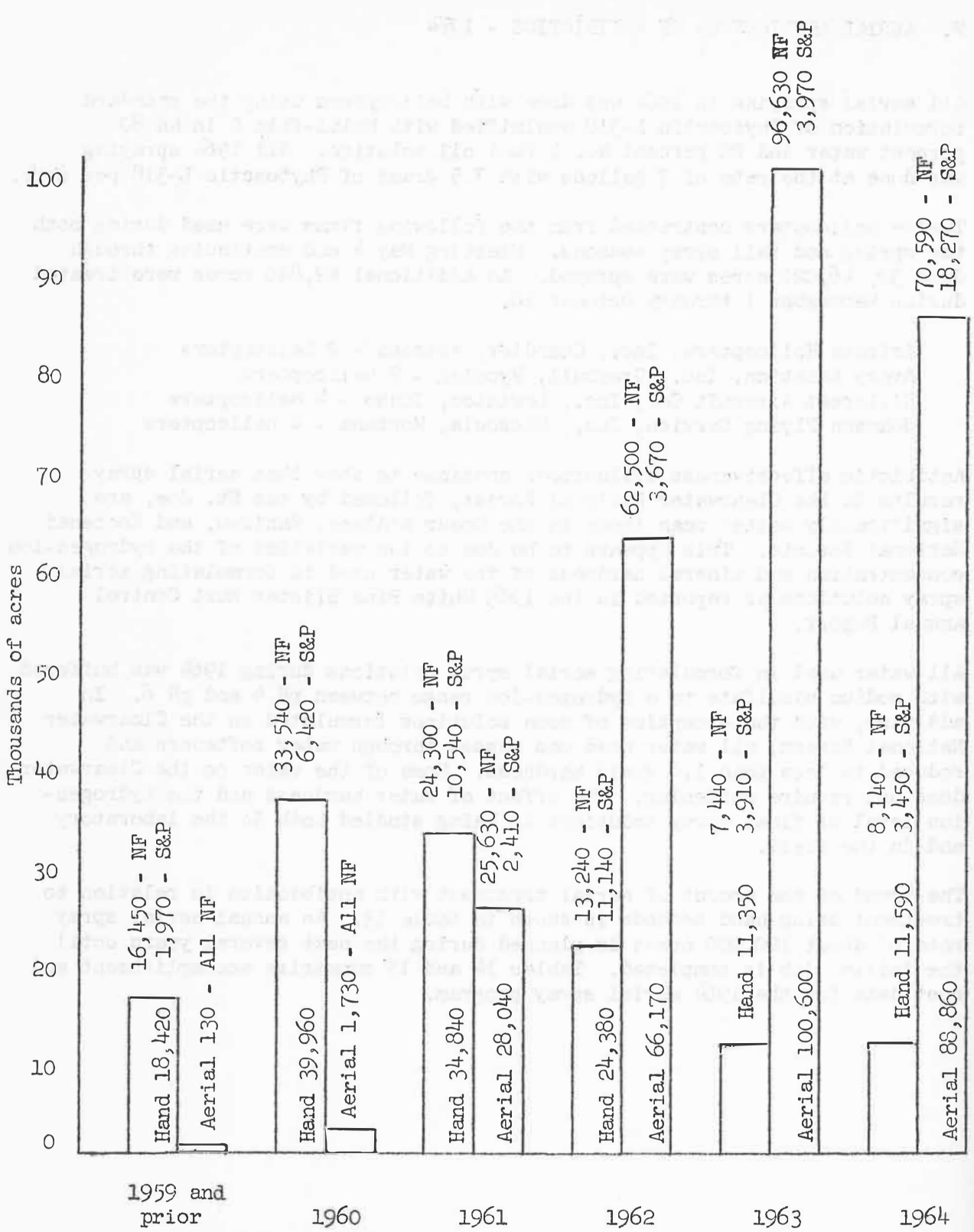
Arizona Helicopters, Inc., Chandler, Arizona - 2 helicopters
Avery Aviation, Inc., Greybull, Wyoming - 2 helicopters
Hillcrest Aircraft Co., Inc., Lewiston, Idaho - 4 helicopters
Johnson Flying Service, Inc., Missoula, Montana - 4 helicopters

Antibiotic effectiveness evaluations continue to show that aerial spray results in the Clearwater National Forest, followed by the St. Joe, are significantly better than those in the Coeur d'Alene, Kaniksu, and Kootenai National Forests. This appears to be due to the variation of the hydrogen-ion concentration and mineral hardness of the water used in formulating aerial spray solutions as reported in the 1963 White Pine Blister Rust Control Annual Report.

All water used in formulating aerial spray solutions during 1964 was buffered with sodium bisulfate to a hydrogen-ion range between pH 4 and pH 6. In addition, with the exception of some solutions formulated on the Clearwater National Forest, all water used was passed through water softeners and reduced to less than 1.0 grain hardness. Some of the water on the Clearwater does not require softening. The effect of water hardness and the hydrogen-ion level of final spray solutions is being studied both in the laboratory and in the field.

The trend of the amount of aerial treatment with antibiotics in relation to treatment using hand methods is shown in table 13. An annual aerial spray rate of about 100,000 acres is planned during the next several years until the initial job is completed. Tables 14 and 15 summarize accomplishment and cost data for the 1964 aerial spray program.

Table 13.--Region 1 summary of antibiotic treatment through 1964 (National Parks not included)



These figures include a few acres treated previously where retreatment has been necessary.

Table 14.--Production summary of 1964 aerial (helicopter) spraying

Item	Forest				Total average
	Clearwater	Coeur d'Alene	Kaniksu	St. Joe	
Acres sprayed	28,670	23,240	20,360	16,590	88,860
Flight hours - actual spraying	420.5	408.6	339.1	294.4	1,462.6
Flight hours - orientation	24.6	24.2	18.9	28.5	96.2
Flight hours - base ferry	23.4	33.4	20.4	28.4	105.6
No. of spray loads (trips)	2,965	2,499	2,096	1,977	9,537
Gallons solution sprayed	211,400	174,880	146,750	122,390	655,420
Spray trips per hour 1/	7.0	6.8	6.0	6.7	6.6
Gallons sprayed per hour 1/	503	428	433	416	445
Gallons solution per trip 1/	71.3	69.9	70.0	61.9	68.3
Gallons solution per acre	7.38	7.53	7.21	7.38	7.38
Acres sprayed per hour - actual spray time 1/	68.1	56.9	60.0	56.4	60.4
Acres sprayed per hour - all flight time 2/	61.2	52.0	53.8	47.2	53.6
Average spray time per actual flying workday 1/	3.3	2.8	3.5	2.6	3.1
Acres sprayed per day - all available workdays 1/	144	99	92	93	107
Acres sprayed per day - days actual spraying done 1/	228	161	207	144	185
Flight hours, survey and other	3/ 12.2	27.4	53.3	5.2	98.1
Total BRC helicopter use - hours	480.7	493.6	431.7	356.5	1,762.5

Most of the spraying on the Clearwater National Forest was done with Hiller 12-E helicopters. Other Forests had Bell models G-3, G-3B, or G-3B1.

1/ Per one helicopter.

2/ Per one helicopter, does not include 1964 survey or mapping time for the benefit of future spraying or test plot time.

3/ Includes 7.4 hours of ribes eradication spraying.

Table 15.--Per acre cost summary of 1964 aerial (helicopter) spraying

Item	Forest				Total average
	Clearwater	Coeur d'Alene	Kaniksu	St. Joe	
Acres sprayed	28,670	23,240	20,360	16,590	88,860
Phytoactin	$6.89	$7.27	$6.80	$7.09	$7.02
Helicopter time	1.81	2.12	2.34	2.25	2.13
Salaries	.41	.58	.60	.58	.54
Meal subsidy and per diem	.08	.05	.13	.07	.08
Fuel oil	.26	.24	.22	.21	.23
Multi-film L, $NAHSO_4$ and other spray materials and supplies	.05	.05	.04	.03	.04
Helispot construction	.03	.14	.38	.05	.15
Roads and plowing snow	.13	.01	.01	--	.04
Other - equipment use, camp construction, trailers, etc.	.17	.24	.20	.31	.23
Totals - cost per acre	$9.83	$10.70	$10.72	$10.59	$10.46

Cost of all aerial survey and mapping done as part of the actual spray projects is included. Other flying time used for surveying and mapping in preparation of future treatment plans is not included.

VI. SCOUTING FOR WHITE PINE BLISTER RUST - 1964

In cooperation with the National Park Service, scouting for white pine blister rust was done in the States of Wyoming, northern Colorado, northeastern Utah, and southeastern Idaho.

A total of 15,070 white pines and 24,860 ribes were examined in 76 drainages on 12 National Forests, 3 National Parks, 1 National Monument, and 1 Indian Reservation. This included white pine examination on two National Forests by Region 4.

The disease was found for the first time on Lonesome Creek about 9 miles southwest of Pollock, Idaho, Payette National Forest. This does not represent spread beyond previous known limits on white pine. Rust has been intensifying south of this location near Brundage Mountain since 1951 when it was first found on Pinus albicaulis which had become infected in 1945.

An intensive disease survey was made by National Park Service personnel on 19,550 acres in Yellowstone National Park. Refer to the National Park Service section in this report for more detailed information.

Table 16.--Scouting summary - 1964

Inspection location	No. of drainages sampled	No. of white pine examined	No. of ribes examined	Pine infection found	Ribes infection found
Wyoming					
Yellowstone N.P.	13	8,750	11,260		
Grand Teton N.P.	3	1,020	750		
Bridger NF	1	20	120		
Medicine Bow NF	4	30	1,680		
Shoshone NF	17	1,980	3,300		2
Teton	2	400	550		
Colorado					
Rocky Mountain N.P.	5	1,400	1,000		
Pike NF	2	430	290		
Roosevelt NF	7	800	1,160		1
San Isabel NF	2	--	630		
White River NF	1	--	240		
Utah					
Dinosaur N.M.	1	--	40		
Uintah Ind. Res.	1	--	150		1
Ashley NF	3	--	1,030		1
Cache NF	3	10	250		
Wasatch NF	6	100	1,230		1
Idaho					
Cache NF	1	10	810		
Caribou NF	1	80	370		
Payette NF	2	30	--	2	
Salmon NF	1	10	--	1	
Total all States	76	15,070	24,860	3	1/ 6

1/ All ribes infection found has been examined by laboratory techniques and determined to be Pinyon rust (C. occidentale) and not white pine blister rust.

VII. STATISTICAL TABLES

Statistical tables summarizing accomplishments and expenditures on a calendar year basis for each program and a total of all programs is presented in this section.

An explanation of the tables for the total of all programs follows. The tables for individual programs are similar.

1. Blister Rust Control Expenditures.

   All funds expended in Region 1, including research reimbursement items, for developmental work during fiscal year 1964, July 1, 1963 through June 30, 1964.

2. Field Organization.

   Self-explanatory.

3. Total Progress of Ribes Eradication.

   All areas worked either initially or reworked are included. The area in table 4 and all work done with Sale Area Betterment (K-V) funds is included.

4. Chemical Eradication.

   This table shows the acres sprayed with 2,4,5-T herbicide to eradicate ribes. The application was from truck-mounted or backpack sprayers. These data are included in table 3.

5. Antibiotic Treatment.

   The number of trees treated is determined from random plot counts. The gallons of solution reported are almost all Acti-dione BR solution for the hand treatments and all Phytoactin for the aerial treatments. A small amount of Phytoactin solution was used on some hand treated areas.

6. Surveys.

   a. Type - Ribes. Includes all types of checking, disease surveys, and pre-eradication surveys done for the purpose of ribes eradication.

   b. Type - Antibiotic. Includes all types of survey work done for the purpose of determining areas to be treated with antibiotics. Flying time directly connected with actual spraying is not included. Systematic inspection of treated areas to determine effectiveness is also included.

7. Net Acres of White Pine by Age Classes.

This table includes all areas satisfactorily stocked with white pine. The areas reported for the National Forest, and the State and Private programs have 20 percent or more white pine stocking. All areas that have been approved for white pine management and those areas where the present stand can be brought through to maturity with the application of antibiotics alone and without ribes eradication are included. Areas of white pine sites presently unsatisfactorily stocked or protection zones are not included. The data reported for the National Forest program include only National Forest and Public Domain land. The data reported for the State and Private program include only State and private lands.

8. Accumulative Summary of Antibiotic Treatment.

The acres reported as treated to date include some that have been retreated.

9. Ownership in Blister Rust Control Programs.

The area shown as National Forest program includes only National Forest and Public Domain lands. Only State and private land is included in the State and Private program. Intermingled lands have been separated and are reported in the respective programs on the basis of ownership.

SUMMARY OF ALL PROGRAMS

1. Blister Rust Control Expenditures, Fiscal Year 1964

State	U.S. Forest Service, Region 1					National Park Service	State and Private	Total
	042	720	411	K-V	Total			
Idaho	1,294,582	16,460	134,088	189,992	1,635,122	--	126,044	1,761,166
Mont.	172,603	--	--	7,014	179,617	66,531	--	246,148
Wash.	153,629	--	--	17,606	171,235	--	--	171,235
Colo.	--	--	--	--	--	23,642	--	23,642
Wyo.	--	--	--	--	--	100,699	--	100,699
Total	1,620,814	16,460	134,088	214,612	1,985,974	190,872	126,044	2,302,890

This table includes all Regional Office and Development and Improvement Expenditures.

042 - Federal funds for National Forest program.
720 - Leadership and technical direction on non-Federal lands.
411 - Federal matching funds for State and Private cooperative programs.
K-V - Stand improvement collections used for BRC on National Forest lands.

2. Field Organization - 1964

Program	Camps	Employees		Total employees
		Ribes eradication	Antibiotic treatment	
National Forest	18	225	121	346
National Park	4	91	20	111
State & Private	4	33	98	131
All programs	26	349	239	588

3. Total Progress of Ribes Eradication - 1964

Ownership	Acres	Man-days	Ribes	Per acre	
				Man-days	Ribes
National Forest	7,060	7,346	2,284,300	1.04	324
National Park	18,230	4,340	853,000	.24	47
State & Private	1,870	1,529	103,400	.82	55
Total	27,160	13,215	3,240,700	.49	119

SUMMARY OF ALL PROGRAMS

4. Chemical Eradication - 1964

Ownership	Acres	Man-days	Ribes destroyed	Gallons of spray solution	Man-days per acre
National Forest	1,010	1,665	1,778,900	265,400	1.65
National Park	220	920	687,000	42,900	4.18
Total	1,230	2,585	2,465,900	308,300	2.10

5. Antibiotic Treatment - 1964

Ownership	Method	Acres treated	Trees treated	Gallons solution	Man-days	Helicopter hours
National Forest	Hand	8,140	298,800	29,850	3,992	--
	Aerial	70,590	7,689,700	521,090	1,621	1,313
	Total	78,730	7,988,500	550,940	5,613	1,313
National Park	Hand	1,880	71,400	1,500	380	--
State & Private	Hand	3,450	332,700	12,200	1,876	--
	Aerial	18,270	2,035,800	134,330	450	352
	Total	21,720	2,368,500	146,530	2,326	352
Total	Hand	13,470	702,900	43,550	6,248	--
	Aerial	88,860	9,725,500	655,420	2,071	1,665
	Total	102,330	10,428,400	698,970	8,319	1,665

6. Surveys - 1964

Ownership	Type	Acres	Man-days	Helicopter hours
National Forest	Ribes	28,450	118	--
	Antibiotic	437,300	1,305	54.6
	Total	465,750	1,423	54.6
National Park	Ribes	28,130	480	--
State & Private	Ribes	30,940	33	--
	Antibiotic	226,610	446	35.5
	Total	257,550	479	35.5
Total	Ribes	87,520	631	--
	Antibiotic	663,910	1,751	90.1
	Total	751,430	2,382	90.1

7. Net Acres of White Pine by Age Classes - 1964

Ownership	Age classes by date of origin						Total acres
	1980-1961	1960-1941	1940-1921	1920-1881	1880-1841	1840 & prior	
National Forest	11,540	27,350	234,730	416,710	106,370	347,920	1,144,620
National Park	- - - - - - - - - - - Not classified - - - - - - - - - - -						143,030
State & Private	3,980	45,600	114,730	187,480	30,450	164,710	546,950
Total	15,520	72,950	349,460	604,190	136,820	512,630	1,834,600

8. Accumulative Summary of Antibiotic Treatment - 1964

Ownership	Idaho		Montana		Washington		Total	
	Total acres	Treated to date	Total acres	Treated to date	Total acres	Treated to date	Acres	Treated to date
National Forest	937,440	280,170	92,840	28,110	114,340	28,665	1,144,620	336,940
National Park 1/	--	--	13,900	10,790	--	--	13,900	10,790
State & Private	490,820	62,560	10,150	--	45,980	--	546,950	62,560
Total	1,428,260	342,730	116,890	38,900	160,320	28,660	1,705,470	410,290

1/ Only Glacier National Park has an antibiotic treatment program.

9. Ownership of Areas in Blister Rust Control Program - 1964

Item	National Forest	Public Domain	National Park	State	Private	Total
White pine stocked	1,123,400	21,220	143,030	169,940	377,010	1,834,600
Protection zone areas	137,060	1,540	--	21,770	49,860	210,230
Total	1,260,460	22,760	143,030	191,710	426,870	2,044,830

FEDERAL LANDS

1. Forest Expenditures, Fiscal Year 1964

Forest	042 funds	K-V funds	Total
Clearwater	262,131	147,204	409,335
Coeur d'Alene	381,921	20,400	402,321
Colville	16,320	--	16,320
Kaniksu	352,565	39,443	392,008
Kootenai	101,806	7,014	108,820
St. Joe	338,430	551	338,981
Total	1,453,173	214,612	1,667,785

2. Field Organization - 1964

Forest	Camps	Employees		Total employees
		Ribes eradication	Antibiotic treatment	
Clearwater	5	140	--	140
Coeur d'Alene	4	50	20	70
Colville	1	--	5	5
Kaniksu	5	25	40	65
Kootenai	2	7	8	15
St. Joe	1	3	48	51
All Forests	18	225	121	346

3. Total Progress of Ribes Eradication - 1964

Forest	Acres	Man-days	Ribes	Per acre	
				Man-days	Ribes
Clearwater	3,270	4,197	1,650,000	1.28	505
Coeur d'Alene	1,870	1,749	482,500	.94	258
Kaniksu	1,080	973	80,100	.90	74
Kootenai	610	231	13,300	.38	22
St. Joe	230	196	58,400	.85	254
All Forests	7,060	7,346	2,284,300	1.04	324

FEDERAL LANDS

4. Chemical Eradication - 1964

Forest	Acres	Man-days	Ribes destroyed	Gallons of spray solution	Man-days per acre
Clearwater	700	1,080	1,406,500	186,100	1.54
Coeur d'Alene	290	552	331,000	74,100	1.90
Kaniksu	20	33	41,400	5,200	1.65
All Forests	1,010	1,665	1,778,900	265,400	1.65

5. Antibiotic Treatment - 1964

Forest	Method	Acres treated	Trees treated	Gallons solution	Man-days	Helicopter hours
Clearwater	Hand	520	77,100	4,040	460	--
	Aerial	23,330	1,266,700	172,770	416	381.8
	Total	23,850	1,343,800	176,810	876	381.8
Coeur d'Alene	Hand	150	6,600	600	160	--
	Aerial	23,010	3,681,600	173,140	566	461.9
	Total	23,160	3,688,200	173,740	726	461.9
Colville	Aerial	3,990	397,000	28,750	90	70.3
Kaniksu	Hand	1,910	87,200	9,650	928	--
	Aerial	10,220	1,662,600	73,070	349	189.9
	Total	12,130	1,749,800	82,720	1,277	189.9
Kootenai	Hand	590	39,200	5,280	400	--
St. Joe	Hand	4,970	88,700	10,280	2,044	--
	Aerial	10,040	681,800	73,360	200	209.1
	Total	15,010	770,500	83,640	2,244	209.1
All Forests	Hand	8,140	298,800	29,850	3,992	--
	Aerial	70,590	7,689,700	521,090	1,621	1,313.0
	Total	78,730	7,988,500	550,940	5,613	1,313.0

FEDERAL LANDS

6. K-V Work - 1964

Forest	Ribes eradication		Antibiotic treatment				
	Acres	Man-days	Acres	Man-days	Trees treated	Gallons solution	Helicopter hours
Clearwater	2,350	2,327	--	--	--	--	--
Coeur d'Alene	230	360	560	4	89,600	3,290	11.0
Kaniksu	460	315	940	48	100,400	7,030	27.2
Kootenai	--	--	430	291	29,100	3,860	--
St. Joe	160	136	40	2	2,000	280	1.0
All Forests	3,200	3,138	1,970	345	221,100	14,460	39.2

7. Surveys - 1964

Forest	Type	Acres	Man-days	Helicopter hours
Clearwater	Ribes	1,240	14	--
	Antibiotic	49,650	237	1.0
	Total	50,890	251	1.0
Coeur d'Alene	Ribes	1,600	63	--
	Antibiotic	123,990	283	22.4
	Total	125,590	346	22.4
Colville	Antibiotic	14,410	41	1.6
Kaniksu	Ribes	490	13	--
	Antibiotic	201,590	516	28.6
	Total	202,080	529	28.6
Kootenai	Ribes	600	4	--
	Antibiotic	7,790	60	--
	Total	8,390	64	--
St. Joe	Ribes	24,520	24	--
	Antibiotic	39,870	168	1.0
	Total	64,390	192	1.0
All Forests	Ribes	28,450	118	--
	Antibiotic	437,300	1,305	54.6
	Total	465,750	1,423	54.6

FEDERAL LANDS

8. Net Acres of White Pine by Age Classes - 1964

Forest	Age classes by date of origin						Total acres
	1980-1961	1960-1941	1940-1921	1920-1881	1880-1841	1840 & prior	
Clearwater	9,460	16,330	29,110	51,200	12,430	156,990	275,520
Coeur d'Alene	1,040	7,790	57,020	114,620	6,690	114,430	301,590
Colville	--	--	8,960	12,490	8,680	8,420	38,550
Kaniksu	670	1,300	75,740	151,070	63,670	47,680	340,130
Kootenai	220	1,070	2,600	33,430	--	--	37,320
St. Joe	150	860	61,300	53,900	14,900	20,400	151,510
All Forests 1/	11,540	27,350	234,730	416,710	106,370	347,920	1,144,620

1/ Includes 21,220 acres of Public Domain lands.

9. Accumulative Summary of Antibiotic Treatment - 1964

Forest	Idaho		Montana		Washington		Total	
	Total acres	Treated to date	Total acres	Treated to date	Total acres	Treated to date	Acres	Treated to date
Clearwater	275,520	57,370	--	--	--	--	275,520	57,370
Coeur d'Alene	276,890	81,100	24,700	3,220	--	--	301,590	84,320
Colville	--	--	--	--	38,550	10,870	38,550	10,870
Kaniksu	230,680	47,460	33,660	9,510	75,790	17,790	340,130	74,760
Kootenai	2,840	550	34,480	15,380	--	--	37,320	15,930
St. Joe	151,510	93,690	--	--	--	--	151,510	93,690
All Forests	937,440	280,170	92,840	28,110	114,340	28,660	1,144,620	336,940

STATE AND PRIVATE LANDS

1. Forest Expenditures, Fiscal Year 1964

Forest	Federal funds			State and private funds			Total all funds
	720	411	Total	State	Private	Total	
Clearwater	1,325	58,991	60,316	36,008	27,683	63,691	124,007
Coeur d'Alene	2,195	--	2,195	--	--	--	2,195
Kaniksu	4,439	18,110	22,549	6,151	10,293	16,444	38,993
St. Joe	8,501	58,220	66,721	23,154	18,755	41,909	108,630
Total	16,460	135,321	151,781	65,313	56,731	122,044	273,825

2. Field Organization - 1964

Forest	Camps	Employees		Total employees
		Ribes eradication	Antibiotic treatment	
Clearwater	2	--	58	58
Kaniksu	--	--	5	5
St. Joe	2	33	35	68
All Forests	4	33	98	131

3. Total Progress of Ribes Eradication - 1964

Forest	Acres	Man-days	Ribes	Per acre	
				Man-days	Ribes
Clearwater	240	235	16,500	0.99	69
St. Joe	1,630	1,294	86,900	.79	53
All Forests	1,870	1,529	103,400	.82	55

4. Chemical Eradication - 1964

None.

STATE AND PRIVATE LANDS

5. Antibiotic Treatment - 1964

Area	Forest	Method	Acres treated	Trees treated	Gallons solution	Man-days	Helicopter hours
Within Association	Clearwater	Hand	1,640	290,000	7,430	1,252	--
		Aerial	5,170	384,800	37,340	99	84.2
		Total	6,810	674,800	44,770	1,351	84.2
	Kaniksu	Hand	--	--	--	--	--
		Aerial	4,910	722,800	36,120	140	97.4
		Total	4,910	722,800	36,120	140	97.4
	St. Joe	Hand	1,740	42,200	4,720	615	--
		Aerial	3,600	272,700	26,930	44	70.9
		Total	5,340	314,900	31,650	659	70.9
	Total	Hand	3,380	332,200	12,150	1,867	--
		Aerial	13,680	1,380,300	100,390	283	252.5
		Total	17,060	1,712,500	112,540	2,150	252.5
Outside Association	Clearwater	Aerial	170	9,500	1,290	3	2.5
	Coeur d'Alene	Aerial	230	276,000	1,740	3	4.3
	Kaniksu	Hand	--	--	--	--	--
		Aerial	1,240	255,500	8,810	36	20.8
		Total	1,240	255,500	8,810	36	20.8
	St. Joe	Hand	70	500	50	9	--
		Aerial	2,950	114,500	22,100	125	71.9
		Total	3,020	115,000	22,150	134	71.9
	Total	Hand	70	500	50	9	--
		Aerial	4,590	655,500	33,940	167	99.5
		Total	4,660	656,000	33,990	176	99.5
All Forests	Total	Hand	3,450	332,700	12,200	1,876	--
		Aerial	18,270	2,035,800	134,330	450	352.0
		Total	21,720	2,368,500	146,530	2,326	352.0

STATE AND PRIVATE LANDS

6. Surveys - 1964

Forest	Type	Acres	Man-days	Helicopter hours
Clearwater	Ribes	40	2	--
	Antibiotic	46,870	167	3.8
Coeur d'Alene	Antibiotic	29,000	20	5.0
Kaniksu	Antibiotic	111,370	125	23.1
St. Joe	Ribes	30,900	31	--
	Antibiotic	39,370	134	3.6
All Forests	Ribes	30,940	33	--
	Antibiotic	226,610	446	35.5
	All	257,550	479	35.5

7. Net Acres of White Pine by Age Classes - 1964

Forest	Age classes by date of origin						Total acres
	1980-1961	1960-1941	1940-1921	1920-1881	1880-1841	1840 & prior	
Clearwater	1,580	38,380	46,290	18,560	11,350	49,470	165,630
Coeur d'Alene	--	460	8,150	31,140	2,020	21,670	63,440
Colville	--	--	--	7,450	--	--	7,450
Kaniksu	--	960	31,090	89,230	11,880	12,070	145,230
St. Joe	2,400	5,800	29,200	41,100	5,200	81,500	165,200
All Forests	3,980	45,600	114,730	187,480	30,450	164,710	546,950

STATE AND PRIVATE LANDS

8. Accumulative Summary of Antibiotic Treatment - 1964

Forest	Ownership	Idaho		Montana		Washington		Total	
		Total acres	Treated to date	Total acres	Treated to date	Total acres	Treated to date	Acres	Treated to date
Clearwater	State	49,890	6,580	--	--	--	--	49,890	6,580
	Private	115,740	12,980	--	--	--	--	115,740	12,980
	Total	165,630	19,560	--	--	--	--	165,630	19,560
Coeur d'Alene	State	14,630	450	--	--	--	--	14,630	450
	Private	46,840	--	1,970	--	--	--	48,810	
	Total	61,470	450	1,970	--	--	--	63,440	450
Colville	State	--	--	--	--	710	--	710	--
	Private	--	--	--	--	6,740	--	6,740	--
	Total	--	--	--	--	7,450	--	7,450	--
Kaniksu	State	45,540	12,410	680	--	5,090	--	51,310	12,410
	Private	52,980	1,060	7,500	--	33,440	--	93,920	1,060
	Total	98,520	13,470	8,180	--	38,530	--	145,230	13,470
St. Joe	State	53,400	20,400	--	--	--	--	53,400	20,400
	Private	111,800	8,680	--	--	--	--	111,800	8,680
	Total	165,200	29,080	--	--	--	--	165,200	29,080
All Forests	State	163,460	39,840	680	--	5,800	--	169,940	39,840
	Private	327,360	22,720	9,470	--	40,180	--	377,010	22,720
	Total	490,820	62,560	10,150	--	45,980	--	546,950	62,560

NATIONAL PARKS PROGRAM

1. Expenditures - Fiscal Year 1964

National Park	State	National Park funds	National Forest funds	Total all funds
Glacier	Montana	66,531	1,320	67,851
Grand Teton	Wyoming	236	--	236
Rocky Mountain	Colorado	23,642	--	23,642
Yellowstone	Wyoming	100,463	330	100,793
All Parks		190,872	1,650	192,522

2. Field Organization - 1964

National Park	Camps	Employees		Total employees
		Ribes eradication	Antibiotic treatment	
Glacier	1	--	20	20
Rocky Mountain	1	16	--	16
Yellowstone	2	75	--	75
All Parks	4	91	20	111

3. Total Progress Ribes Eradication - 1964

National Park	Acres	Man-days	Ribes	Per acre	
				Man-days	Ribes
Rocky Mountain	370	710	496,000	1.92	1,340
Yellowstone	17,860	3,630	357,000	.20	20
All Parks	18,230	4,340	853,000	.24	47

4. Chemical Eradication - 1964

National Park	Acres	Man-days	Ribes	Gallons of solution
Rocky Mountain	70	420	467,000	25,100
Yellowstone	150	500	220,000	17,800
All Parks	220	920	687,000	42,900

NATIONAL PARKS PROGRAM

5. Antibiotic Treatment - 1964

National Park	Method	Acres treated	Trees treated	Gallons solution	Man-days	Man-days per acre
Glacier	Hand	1,880	71,400	1,500	380	0.20

6. Surveys - 1964

National Park	Type	Acres	Man-days
Rocky Mountain	Ribes	370	30
Yellowstone	Ribes	27,760	450
All Parks		28,130	480

7. Ribes Eradication Control Status

National Park	Total acres	Unworked areas	Worked area (acres)	
			Needing rework	On maintenance
Glacier	6,010	--	1,820	4,190
Grand Teton	1,010	--	100	910
Rocky Mountain	12,650	2,990	1,060	8,600
Yellowstone	115,470	67,450	8,940	39,080
All Parks	135,140	70,440	11,920	52,780

8. Accumulative Summary of Antibiotic Treatment - 1964

National Park	Acres within ribes eradication units		Acres outside ribes eradication units		Total	
	Total acres	Acres treated to date	Total acres	Acres treated to date	Total acres	Acres treated to date
Glacier	6,010	3,580	7,890	7,210	13,900	10,790
Grand Teton	1,010	--	--	--	1,010	--
Rocky Mountain	12,650	--	--	--	12,650	--
Yellowstone	115,470	--	--	--	115,470	--
All Parks[1/]	135,140	3,580	7,890	7,210	143,030	10,790

1/ Glacier National Park has an antibiotic treatment program. All other Parks have a ribes eradication program only.

WHITE PINE BLISTER RUST CONTROL

Annual Report
Calendar Year 1965

U.S. DEPARTMENT OF AGRICULTURE
FOREST SERVICE
REGION ONE

MISSOULA, MONTANA

1380(5270)

UNITED STATES DEPARTMENT OF AGRICULTURE
FOREST SERVICE
REGION 1

Missoula, Montana
April 1966

WHITE PINE BLISTER RUST CONTROL ANNUAL REPORT
Calendar Year 1965

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The following agencies are conducting or are actively cooperating in white pine blister rust control:

U.S. Forest Service
National Park Service
State of Idaho Forestry Department
Clearwater Timber Protective Association
Potlatch Timber Protective Association
Priest Lake Timber Protective Association
Bureau of Land Management
University of Idaho
Washington State University.

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WHITE PINE BLISTER RUST CONTROL ANNUAL REPORT
Calendar Year 1965

Forest Service
Region 1

Division of State and Private Forestry
Branch of Forest Pest Control

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I. HIGHLIGHTS OF 1965 BLISTER RUST CONTROL PROGRAM

THE OVERALL BLISTER RUST CONTROL PROGRAM

General

A total of 111,690 acres of white pine were treated for blister rust control in 1965. Total National Forest and State and private control program accomplishment on lands of all ownerships was 99,120 acres. The National Park control program accomplishment was 12,570 acres. A total of 605 employees were engaged in blister rust control activities during the season; 500 on National Forest and State and private programs, and 105 on National Parks program. In addition to helicopter contracting, one ribes eradication area was worked by contract during 1965.

The National Forest and State and private control program included some 12,670 acres of immature western white pine treated with antibiotics by the basal stem method. Phytoactin L-318 was applied as a foliar spray by helicopters on 79,870 acres of western white pine. This required 1,430.4 flying hours, including 48.8 hours of survey time. Ribes were eradicated from 6,580 acres; 5,020 acres by hand methods and 1,560 acres by chemical methods, using 2,4,5-T herbicide solutions with power sprayers and helicopters.

The National Park program included 740 acres treated with antibiotics by the basal stem method and ribes eradication on 11,830 acres; 11,500 acres by hand methods and 330 acres by chemical methods. Total white pine areas in the National Forest and State and private program treated with antibiotics to date include 124,400 acres treated by basal stem methods and 336,740 acres treated by aerial methods. Approximately 57,250 acres within these areas have been retreated due to unsatisfactory initial treatment results.

The National Park Service antibiotic treatment program is limited to Glacier Park. Approximately 3,230 acres of the 11,070 acres of white pine treated to date have been retreated.

Antibiotic Treatment Results

A large amount of canker evaluation data was collected during 1965. In order to provide a basis for future evaluation of antibiotic treatments made during 1965, a total of 2,487 cankers on 1,904 trees were selected, marked, and described on forms designed for this purpose. This included a number of untreated trees selected as controls. In addition, 6,026 cankers on 4,229 trees previously selected in areas treated in prior years or set up as controls were carefully examined for treatment effectiveness.

In project treated areas, not including developmental plots, there have been 21,377 cankers on 14,884 trees selected, marked, and described in detail for evaluation purposes. This includes about 1,000 untreated trees.

Data from evaluations, made two or more growing seasons after treatment (prior to 1964), indicate that 30 to 40 percent of the once-vigorous cankers have been controlled by basal stem treatment. Most of the cankers evaluated are in the treatment zone since this is where the majority of lethal cankers occur in stands that are basal stem treated. Some individual areas show 90 percent infection control. It is now apparent that all cankers treated by the basal stem method must also be scarified in order to obtain consistent satisfactory results. This practice was started in 1963.

No project aerial spraying was done prior to 1961. Evaluation data from the 1961 and 1962 aerially treated areas indicate that 24 percent of the vigorous cankers apparently have been controlled.

Observations made during 1965 in mature stands aerially treated with Phytoactin L-318 in 1961 did not show that satisfactory infection control was achieved.

Comparative information taken from untreated areas on the same basis as that from treated areas indicates that 17 percent of the vigorous infections have become inactive. The analysis of this data is complicated by the fact that many of these trees have since been girdled by an infection.

Immunization of Western White Pine Nursery Stock

All western white pine nursery stock outplanted in 1965 received prior antibiotic treatment in an attempt to immunize those trees against blister rust for a 5- to 10-year period. In September 1965, 6.5 million nursery seedlings at both Savenac and Coeur d'Alene were foliar treated with Phytoactin L-318. A total of 700 gallons of 10 percent fuel oil emulsified solution formulated at 200 p.p.m., were used. No specific guarantee can be made regarding immediate or long-range benefits. Current test results appear promising on a short-term (2 to 3 years) basis. Several new tests were established in 1965.

Antibiotic Tests on Limber and Whitebark Pines

Effective antibiotic formulations and/or application techniques still have not been developed for controlling blister rust infections on limber or whitebark pines. Several new formulations and materials were used on test plots established in 1965.

Spread of the Rust

Scouting for new white pine blister rust infections outside the known limits of the rust was conducted in parts of Wyoming and southern Idaho during 1965 with assistance from the National Park Service. Due to time and personnel limitations, only brief and rather widespread examinations were made. The year 1965 was, in general, very poor in these areas for rust development on ribes. Several new white pine blister rust infections were found. The rust is intensifying in several areas where it was found during earlier examinations.

Blister rust infection on ribes in the western white pine areas was, in general, moderate to light. Heavy infection was observed in a few limited areas. Although the last 2 weeks in August appeared to be very favorable for pine infection, 1965 was probably a poor infection year. This prediction is based on the very warm weather experienced during September.

Antibiotic Side Effects

No harmful side effects have been associated with proper antibiotic treatment of pine stands on 410,000 acres. No detectable damage has occurred to fish, wildlife, insects, and beneficial fungi.

Antibiotic Research and Development

During 1965, nine scientists worked full or part time on basic and applied antibiotic research and development related to blister rust control. Four were stationed at the new Forestry Sciences Laboratory at Moscow, Idaho; one was employed under a Phytoactin fellowship at Washington State University; and four were members of the Forest Service Methods Development and Improvement Branch at Spokane, Washington.

Economic Study

Collection of data for the new western white pine production and management economic study was continued. The original study plan which considered only blister rust protection costs has been expanded so as to include all white pine timber growing costs. The basic resource data collection job has been completed. Collection of cost data is continuing. Six employees from Research and Administration worked full or part time on this study which is scheduled for publication in 1966.

New Antibiotic Formulation and Application Techniques

The following formulation improvements were followed in 1965, and other new antibiotic formulations and application techniques were tested:

1. In 1965, all water (except some on the Clearwater National Forest) used in formulating Phytoactin L-318 for aerial spraying was presoftened, and the pH of all final spray solutions was reduced to a range between 4.5 and 6.0.

2. All pine infections directly treated by the basal stem method in 1965 were scarified (adjacent bark broken) to increase spray solution absorption.

3. Several conventional fungicides were applied by the basal stem method directly to infections on whitebark pine.

4. The penetrant, DMSO (dimethyl sulfoxide) and other additives were used on a test basis with Phytoactin spray solutions applied by hand sprayer to seedlings and reproduction.

5. Phytoactin oil miscible formulation, at 2 gallons of spray solution per acre, was applied to four 40-acre western white pine plantation plots by helicopter. Each of the three oil miscible formulations were applied at the rate of 7.5 grams of Phytoactin per acre.

6. Phytoactin L-318 solutions at low volume rates (less than 5 gallons) per acre were applied to western white pine using a backpack power mistblower on a test basis.

CLEARWATER NATIONAL FOREST AND CLEARWATER TIMBER PROTECTIVE ASSOCIATION

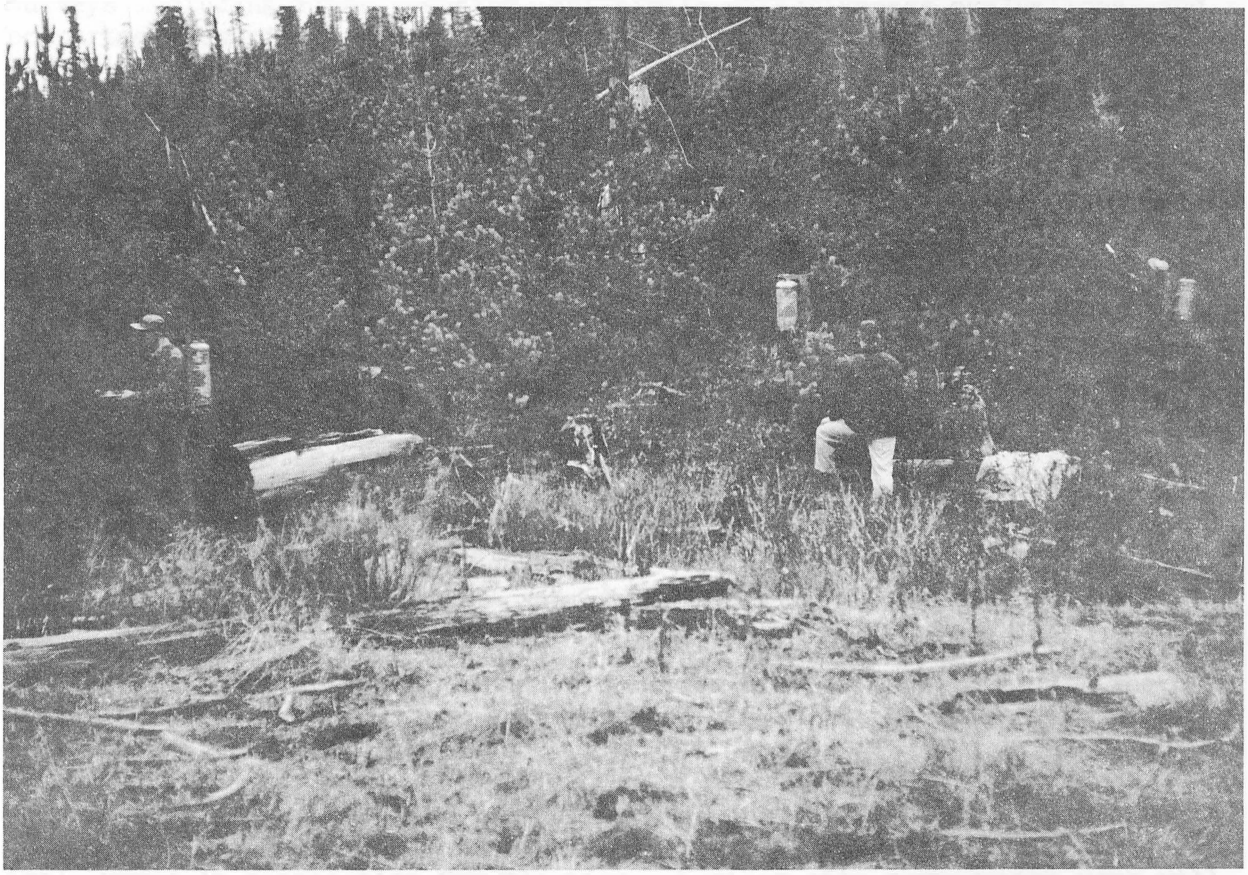
Included in the 12,690 acres treated for blister rust control during calendar year 1965 were 3,640 acres of ribes eradication, 2,400 acres of hand antibiotic treatment, and 6,650 acres of aerial antibiotic treatment. Most of the ribes eradication was done in recent clearcut areas in preparation for planting to western white pine. Aerial antibiotic treatment accomplishments included 4,810 acres of State and private lands within the Clearwater Timber Protective Association. Basal stem work included 1,850 acres of State and private lands in the Deer Creek and Brown's Creek areas.

Chemical eradication on 1,390 acres included 700 acres that were sprayed with a helicopter using 2,4,5-T on the Pierce and Kelly Creek Ranger Districts.

Aerial spraying with 2,4,5-T for ribes eradication done during 1964 in the Nelson-Cole area resulted in about a 50 percent ribes kill. An additional 25 percent of the ribes were severely affected and expected to die. The area was aerially sprayed again in 1965 in an effort to increase eradication effectiveness. Planting of western white pine in this area will be done in the spring of 1966. An eradication cleanup job is scheduled for late season 1966. The cost of each aerial spraying was about $6.50 per acre. Truck mounted spraying and hand eradication costs in this type of heavy ribes area would be much higher. A definite cost comparison can be made as soon as the hand eradication followup work is completed.

A 30-acre block in this same area which was aerially sprayed with Tordon in 1964 was not resprayed this year. First year ribes kill is not as high as that in the area treated with 2,4,5-T, but because of possible residual effects, another examination in 1966 will be necessary before final results can be determined.

There were 195 people employed during the peak of the field season. Control activities were conducted from six field camps, one of which was a mobile trailer camp. This permitted working two widely separated areas with only one camp outfit and a single crew.



Basal stem treatment crew at work in young western white pine stand, Clearwater National Forest.

Antibiotic basal stem retreatment was completed in the Alder and Beaver Creek plantations. Approximately 200 acres of very young white pine in the Sourdough compartment were foliar treated with a Phytoactin L-318 solution using a backpack sprayer.

Ribes eradication accomplishments included initial work in the Tamarack-Pine Creek block, Osier block No. 4, Orofino Creek, Armstrong Gulch Cedars block, Independence block No. 15, China Creek block 6, Moose Creek block 7, Musselshell compartment, and the Lolo Creek compartment.

Surveys including ribes checking, antibiotic effectiveness evaluations, and compartment examinations for stocking and damage information covered over 75,000 acres and required 725 man-days. Efforts to evaluate antibiotic treatment effectiveness included 113 man-days to examine 1,118 cankers on 1,000 trees on 38 study strips in areas treated during previous years; and 57 man-days marking 346 cankers on 274 trees on 10 study strips established in areas treated during 1965. Very few man-days were lost to fire control activities. Part of the crew stationed at the Sheep Mountain camp was used during a July fire storm on the Canyon District. During the same period part of the crew stationed at the Deer Creek camp was used for fire control by the Clearwater Timber Protective Association.

An unusual amount of effective time was lost during 1965 because of rainy weather. Three times the average precipitation was received during August which is usually the most productive month.

No ribes eradication contracting was done during 1965. Three eradication areas in the Orofino and Musselshell compartments have been selected and prepared for contracting in 1966.

This year's evaluation of the ribes areas treated with Dybar pellets in 1964 indicates that this type of eradication does not show much promise. The cost of this material is very high on a per acre basis and the percentage of ribes kill was not satisfactory.

Western white pine planting accomplishments in 1965 included 711 acres in the China Creek and Moose Creek compartments. An additional 500 acres were control burned in preparation for planting. Further site preparation work will be required on about 60 acres of this in two of the blocks because of unsatisfactory burn.

Conditions for the spread and intensification of the rust were not as favorable as might be expected. Conditions were very favorable during the last 2 weeks of August, but September had above normal temperatures and below normal precipitation.

Although safety was continually stressed as part of the work program in each camp, the project had six chargeable accidents during the season. Two of these resulted in lost time.

COEUR D'ALENE NATIONAL FOREST

White pine blister rust control was accomplished in 1965 by ribes eradication and the application of antibiotics to selected white pine stands using aerial and basal stem methods. A total of 24,150 acres were treated, including 990 acres of ribes eradication, 840 acres of basal stem treatment, and 22,320 acres sprayed with helicopters.

Four camps were located at Hudlow, Trail Creek, Upper Independence Creek, and the Shoshone Work Center. Peak employment reached 81, including kitchen crews and administrative overhead.

Ribes eradication was confined to the protection of established white pine plantations less than 10 years of age, and to areas being prepared for planting. Initial work was done on 300 acres, and 610 acres were reworked in the Flat Creek, Tepee Creek, Potter Creek, and Burnt Cabin compartments. A truck-mounted sprayer was used to selectively spray 80 acres with 2,4,5-T in the Burnt Cabin and Flat Creek compartments.

Crews at three camps, Hudlow, Shoshone, and Independence, treated young white pine stands with antibiotics. All stands treated were examined prior to treatment with a systematic compartment examination survey. Only those stands where the treatable, diseased trees are needed for minimum stocking were treated. This work was done in the Snowbird, Tom Lavin, Honey Creek, and Clay Creek compartments.

Helicopters were used to apply the antibiotic Phytoactin to selected white pine stands on the Wallace, Kingston, Fernan, and Magee Districts during the spring and fall. During the spring program 14,530 acres of white pine on Federal land were treated. Some 770 acres of State of Idaho land located in the Spring Creek, Smith Creek, and Fall Creek drainages on the Kingston District were sprayed. Some 7,020 acres in the Brett Creek, Cathedral, and Jordan Creek compartments on the Magee District, where early treatments by aerial and basal stem methods did not give satisfactory results, were retreated. Fall spraying plans were curtailed slightly due to rainy weather and unusually high winds.

Increasing the number of helicopters from two to three at some of our helispots resulted in more efficient use of equipment and personnel, and overall savings.

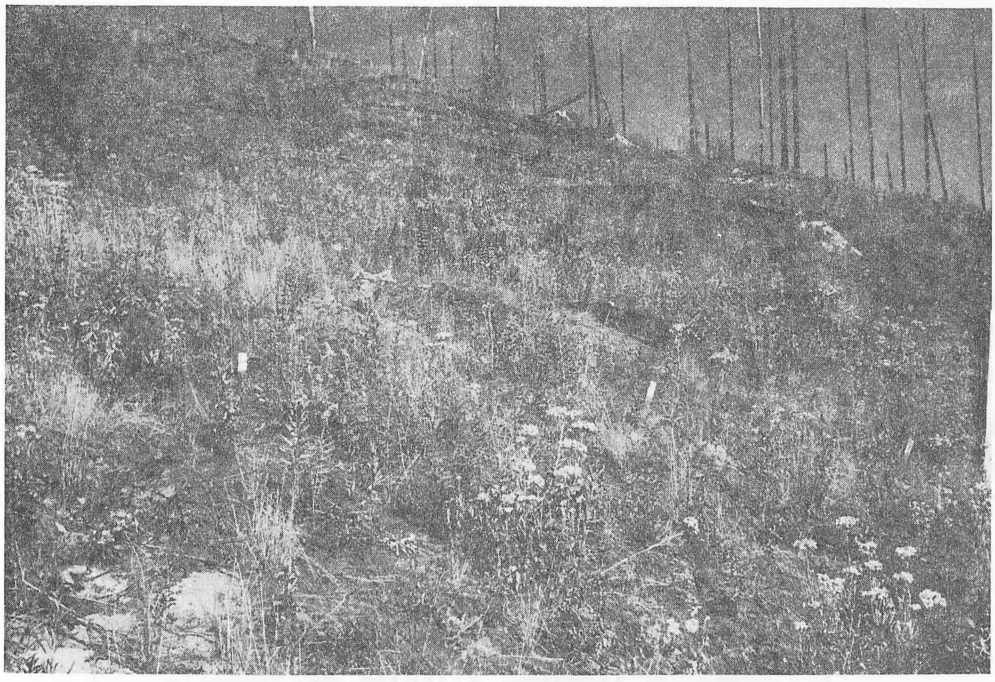
A six-man survey crew examined cankers for treatment effectiveness on 16 established line plots, and established 16 new study strips. A total of 604 cankers on 344 trees were evaluated on previously marked plots, and 626 cankers on 485 trees were examined and marked for future evaluation. A two-man crew examined 3,230 acres of pole-size and younger white pine to determine treatment needs.

Brett Creek plantation area. This photo was taken in 1944, 2 years after prescribed burning, Coeur d'Alene National Forest.

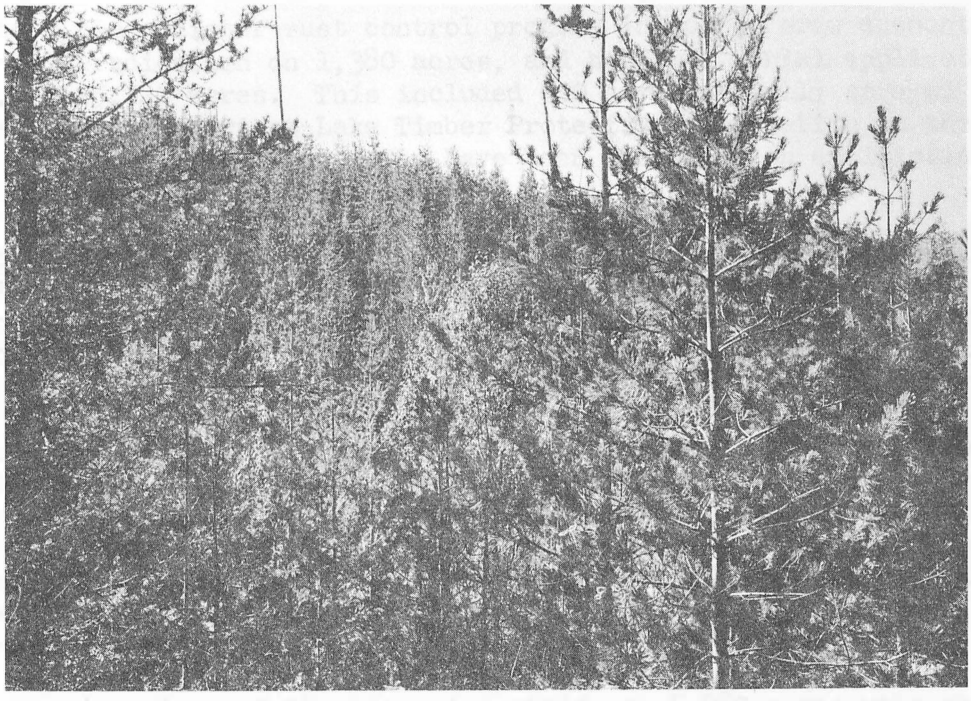
The same area 11 years later. Photo was taken in 1955, Coeur d'Alene National Forest.

The same area. This photo was taken in 1965, Coeur d'Alene National Forest.

Cathedral plantation planted in 1924. Many trees have reached merchantable size. This photo was taken in 1965, Coeur d'Alene National Forest.



Davey Creek plantation area. The area was burned in 1931 and planted in 1935. This photo was taken in 1938, Coeur d'Alene National Forest.



The same area on the far slope. This photo was taken from a slightly different point in 1965, 34 years after burn. Area was aerially treated with Phytoactin in 1965, Coeur d'Alene National Forest.

A total of 170 acres were planted to white pine during the spring and fall of 1965. This included 130 acres in the Yellow Dog compartment and 40 acres in the Flat Creek compartment.

Fire training required 68 man-days, but no project worktime was lost to fire suppression during the year. Considerable worktime was lost due to rain and poor weather.

The 1965 blister rust control safety program was very effective. The project had only one nonchargeable injury and there were no lost-time or vehicle accidents.

Mr. Harry J. Faulkner, staff officer in charge of Insect and Disease Control, retired December 30, 1965, after more than 35 years of service. His high quality leadership and wide range of blister rust control experience will be missed very much.

KANIKSU AND COLVILLE NATIONAL FORESTS AND PRIEST LAKE TIMBER PROTECTIVE ASSOCIATION

The 1965 white pine blister rust control program included force account and contract ribes eradication on 1,380 acres, and hand and aerial application of antibiotics on 25,720 acres. This included 600 acres aerially sprayed with antibiotics within the Priest Lake Timber Protective Association in the Snow Creek area. A total of 123,480 acres have been treated with antibiotics since the program was started in 1957.

Contract ribes eradication was revived this year after a lapse of several years. A trial area of 47 acres was prepared for contract, and a low bid of $11 per acre was received. On the basis of this very satisfactory contract, five additional areas totaling 240 acres were prepared for contract award in the spring of 1966.

The peak season employment of 90 men included a 10-man ribes camp at Goose Creek on the Falls District and a 30-man basal-stem camp at Kalispel Creek on the Priest Lake District. A 10-man ribes crew worked on the Sullivan Lake District of the Colville National Forest early in the season. After completion of work there, the crew was moved to Headquarters. In addition, a 10-man basal-stem crew and all checkers, evaluators, and survey personnel were stationed at Headquarters.

Compartment examinations of 25 white pine stands on 5,280 acres were made this year to determine stocking levels, treatment needs, and priorities.

Very little time was lost to fire suppression, but this was somewhat offset by time lost to rainy weather.

Evaluation of antibiotic treatment effectiveness included establishing 11 new strips with 522 cankers on 425 trees in areas treated this year, and evaluating 2,005 cankers on 1,503 trees on 41 strips in areas that were treated in previous years. One hundred and eight artificial inoculations were made, and 62 needle samples were collected for bioassay determinations of antibiotic quantity.

Two barracks buildings, a messhall, and a gashouse were completed at the new combination Priest Lake Ranger District and blister rust control administrative site. Two residences, two warehouses, and a heated storage shed are planned for construction next summer.

The safety award program worked very well again this year. Only one reportable accident occurred when an employee was cut while replacing a sheath on a crosscut saw.

Two key men in our organization, Clem Wallace and Ish Warren, retired December 30, 1965, after serving 34 and 23 years, respectively.

KOOTENAI NATIONAL FOREST

During 1965, a total of 6,570 acres were treated to control blister rust. Aerial treatment was completed on 6,020 acres of pole-size white pine in the Burnt, Cyclone, and Red Top compartments. Basal stem treatment was completed on 290 acres in the South Fork of Callahan compartment. Ribes were eradicated from 260 acres of clearcut blocks in Pete Creek. This included 30 acres that received chemical treatment.

Fifteen workers were employed on all phases of blister rust control work. The crews were quartered at the Troy and Sylvanite Ranger Stations. No temorary camps were necessary.

Efforts to evaluate antibiotic treatment effectiveness required 104 man-days to:

1. Examine 137 cankers on 105 trees on five study strips in areas previously treated on the Troy and Yaak Districts.

2. Marking 177 cankers on 150 trees on five study strips established in areas treated during 1965.

3. Collecting needle samples for bioassay determinations.

4. Examining several special test areas.

Compartment examination surveys were started in September and will be continued. Disease-free white pine and associated species stocking is being found adequate in some areas, and no antibiotic treatment will be necessary.

ST. JOE NATIONAL FOREST AND POTLATCH TIMBER PROTECTIVE ASSOCIATION

There were 119 workers employed on blister rust control during 1965. This included three field camps, an antibiotic aerial spray unit, and Headquarters personnel.

Three 30-man field camps were located in the following areas:

1. Hume Creek - Acti-dione was used to basal stem treat young white pine on 2,250 acres of Federal, 110 acres of State, and 190 acres of private land in the Ramskull, Willow, and West Fork Charlie Creek drainages. In addition, crewmen removed ribes from 183 acres of Federal land recently planted to white pine in Ramskull and Hume Creek.

2. Marble Creek - Acti-dione was applied to immature white pine on 2,270 acres of Federal, 190 acres of State, and 50 acres of private land. Work was done in the Davies, Hobo, Cranberry, and Bussel drainages.

3. Elk River - crews stationed at the Forest Service work center applied Acti-dione to 1,890 acres of State, 750 acres of private, and 330 acres of Federal white pine in the Elk River, Lindley, Shattuck, Squaw, and Cameron drainages.

The aerial spray unit used three helicopters to apply the antibiotic Phytoactin to 12,800 acres of Federal, 5,100 acres of State, and 2,370 acres of private white pine pole stands during the spring, summer, and fall spray periods. Phytoactin was applied to immature white pine stands in the Elk River, East Fork Bear, Carpenter, Charlie, East Fork Meadow, and Little Bear drainages.

The aerial spray unit also assisted in the Douglas-fir tussock moth cooperative control project in the Moscow-Potlatch-Tensed area during the period June 10-26. BRC personnel, equipment, and six contracted helicopters were used to apply the insecticide DDT to about 33,000 acres of Douglas-fir and grand fir timber type. The project was under the direction of the Idaho State Forestry Department.

White pine was planted on 238 acres of Federal land in the following areas during the spring of 1965:

1. Ramskull Creek, 24 acres.
2. Hume Creek, 48 acres.
3. Beaver Creek, 15 acres.
4. Fisher Creek, 92 acres.
5. Burn Creek, 19 acres.
6. East Fork Bear Creek, 40 acres.

A two-man survey team completed a detailed compartment examination on 37 white pine stands during the 1965 field season. The stand composition, timber stocking, growth potential, and disease and insect conditions were evaluated and recorded on 13,400 acres within approved white pine management units. This information will be used in plans for future insect and disease control work. Efforts to evaluate antibiotic treatment effectiveness included 206 man-days examining 2,162 cankers on 1,277 trees on 48 study strips in areas previously treated; and 80 man-days marking 816 cankers on 570 trees on 13 study strips established in areas treated during 1965.

Planned control work during the 1966 field season will be carried on near Clarkia, Boville, and Elk River. A 30-man unit located on Marble Creek will complete the basal stem antibiotic treatment of white pine stands in the Bussel drainage. This unit will be moved to Clarkia later in the season to complete antibiotic treatment in Hatton and Bechtel Creeks. Another 30-man camp will be located at Bob's Creek and will apply Acti-dione to white pine in the East Fork Bear and Corral drainages. In addition, crewmen will eradicate ribes from stream zones in both West Fork and East Fork Potlatch Creeks. The third camp will be located at Elk River and will eradicate ribes in the Fisher-Cranberry area to protect recently established white pine plantations. Eradication will also be done in the stream type zones on Elk, Squaw, Shattuck, and Cameron Creeks to destroy patches of Ribes petiolare that have come into the moist stream bottoms during the past 10 years.

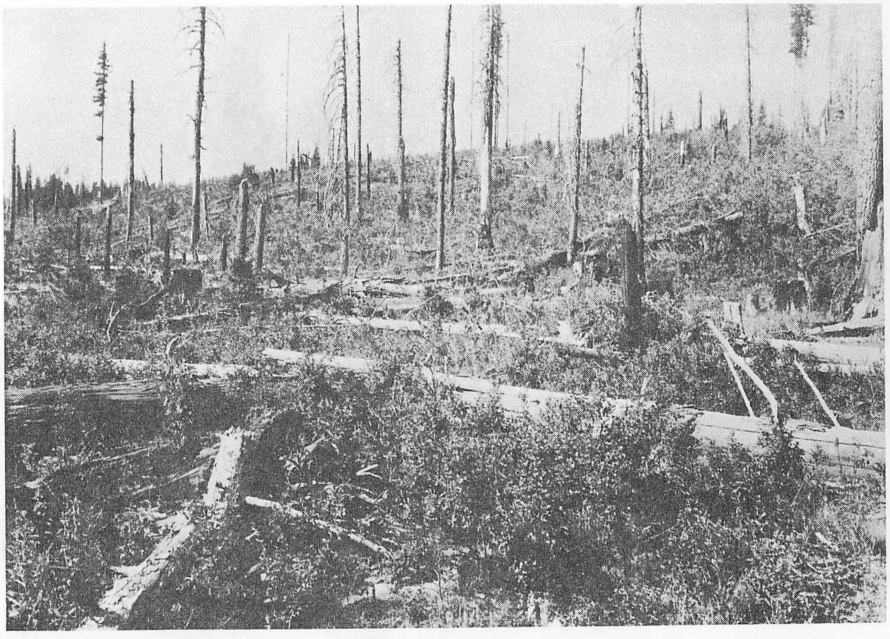
A helicopter will be used to apply herbicides to several recently burned clearcut areas prior to the planting of white pine. The use of helicopters for this work offers an economical method of destroying the numerous ribes seedlings that usually germinate after soil disturbances.

Weather conditions were extremely damp again this summer. Over twice the normal amount of rain fell between June 1 and August 31. Project crewmen were given fire control training, but were not called for fire suppression during the summer. The wet weather resulted in 730 man-days being spent on projects other than antibiotic treatment and ribes eradication.

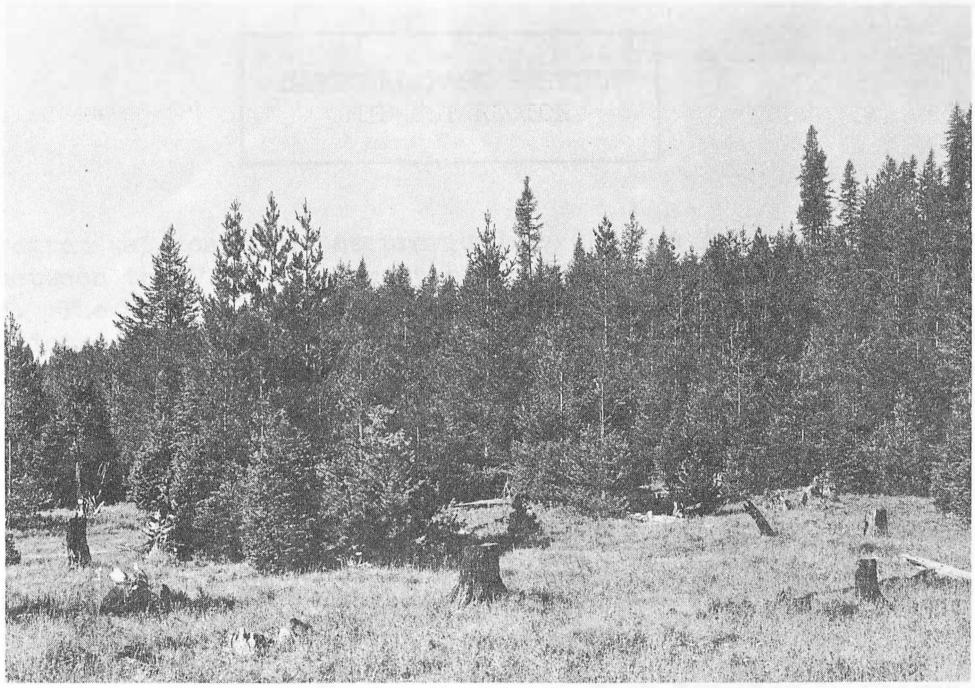
The construction of a 20-stall BRC vehicle and equipment storage shed was completed at the Clarkia Ranger District and Blister Rust Control combination administrative site during November 1965. All equipment and supplies have been transferred from the former BRC headquarters in the old Rutledge Lumber Company camp and the move is now complete.

The project had 1 chargeable and 25 nonchargeable injuries, and two vehicle accidents during 1965.

Blister rust damage to unprotected whitebark pine stand on Bitterroot Divide at the head of Gold Creek, St. Joe National Forest.



This area, located on Cameron Creek west of Elk River, was logged in 1914 or 1915 and broadcast burned about 1917. The white pine stand has been protected from blister rust since 1933. The two following pictures reveal the changes and developments that have taken place. The above photograph was taken in 1931, St. Joe National Forest.



The same area 19 years later. Camera point has been moved back 60 feet. This photograph was taken in 1950, St. Joe National Forest.

The same area 15 years later. This photograph was taken in 1965, St. Joe National Forest.

NATIONAL PARK SERVICE
MIDWEST REGION

The 1965 program was conducted as provided by the Lea Act, and the current agreement between the U.S. Department of Interior and the U.S. Department of Agriculture. The National Park Service has complete responsibility for planning, operational activities, and coordination between the Parks involved in blister rust control activities. The U.S. Forest Service furnishes interagency leadership and assistance in accordance with the agreement between the two agencies.

Personnel Participating

Glacier	Charles A. Budge, Supervisory Park Ranger-in-Charge
Yellowstone	Marion W. Myers, Park Forester-in-Charge John N. Reeves, Forestry Technician, Project Supervisor
Rocky Mountain	Robert K. Weldon, Park Forester-in-Charge
Regional Program	John C. Gynn, Forester-in-Charge (deceased) F. F. Dickison, Forester
U.S. Forest Service, Northern Region	David A. Graham, Section Head, White Pine Blister Rust Control Virgil D. Moss, Chief, Methods Development and Improvement Branch Donald H. Brown, Forester, Methods Development and Improvement Branch

Glacier National Park

Abnormal seasonal rains and inclement weather which continued throughout the season prevented accomplishing all work planned for the 1965 season. Initial basal stem antibiotic work was done in the Coal Creek unit, and some areas in the North Fork, Lake McDonald, and McDonald Creek units were retreated. No ribes eradication work was done.

Accomplishments included initially treating 47,500 immature western white pine trees on 280 acres, and retreating 76,500 immature trees on 460 acres. The antibiotic formulation Phytoactin L-440 at 200 p.p.m., in a No. 1 fuel oil with surfactant was used. Only the basal stem direct canker treatment method with scarification was used. The retreatment areas had been originally treated with Acti-dione and did not respond satisfactorily. All work during the 1965 season was done west of the Continental Divide.

Cooperation with the U.S. Forest Service in evaluating and establishing whitebark and limber pine studies was continued. Study plots include basal stem and aerial (helicopter) applications. An effective treatment for blister rust on these high-altitude white pines is urgently needed.

Yellowstone National Park

The recent disease surveys (1964) indicate the rust is intensifying in the northern portions of the Park and spreading southward. This development changed eradication working priorities. Unworked areas, now included in the control program, will be worked as soon as possible. Ribes eradication work in 1965 was confined to the West Thumb and Obsidian Cliff units where the surveys showed blister rust infection, and to the Lake Shore area where there were heavy concentrations of ribes and a high rust inception potential.

All objectives scheduled for 1965 were achieved or surpassed. Initial ribes eradication was accomplished on 9,450 acres requiring 3,220 man-days. An additional 1,960 acres were maintained with touchup rework as scheduled. Included in the areas worked initially are 280 acres treated by chemical eradication methods. A considerable amount of ribes status checking was done in several of the control areas to determine stabilization factors and the amount of rework and maintenance control work needed.

The 1965 season was the first time that ribes eradication was conducted in any control units that have blister rust infection. No new infections were found this year. No infection on pine has been found in the units originally selected for protection.

Grand Teton National Park

No ribes eradication was done during 1965. The area was scouted for rust during the fall inspection trip and one Ribes viscosissimum specimen was collected with rust which was later identified as Cronartium occidentale (pinon rust). White pine blister rust has been found on limber pine in this area.

Rocky Mountain National Park

Initial ribes eradication was completed on 330 acres. Included were 50 acres of heavy ribes, at timberline and in the ski runs in the upper Hidden Valley unit, that were sprayed with portable power units. An additional 90 acres were reworked as scheduled. Highly susceptible ribes occurring en masse along the ski trails, blowdown, and stream type are being eradicated with 2,4,5-T spray solutions.

The crew consisted of 15 well-trained men under the direction of an experienced BRC camp superintendent. They assisted the ranger division several times on rescue missions, but no time was lost to fire control.

Surveys and Scouting

A systematic white pine-ribes distribution and disease survey was conducted within Bryce Canyon National Park and Cedar Breaks National Monument, Utah. The purpose of the survey was to determine:

1. If the disease is present.

2. The amount and distribution of the two white pine species, Pinus flexilis and P. aristata.

3. The amount and distribution of ribes by species.

4. Topography.

5. Microclimate data that may describe conditions for inception of the disease.

The information collected will be used in planning future scouting inspection activities. A total of 11,380 acres were surveyed. No white pine blister rust infection was found on white pine or ribes.

An effective safety program, plus a high percentage of returning supervisory and experienced workers, contributed to a very good year. There were no vehicle or lost-time accidents. Only a very few minor reportable accidents occurred.

II. ANTIBIOTIC AND HERBICIDE DEVELOPMENT AND IMPROVEMENT WORK FOR WHITE PINE BLISTER RUST CONTROL

Field and laboratory accomplishments include: (1) western white pine studies, (2) whitebark pine studies, and (3) ribes eradication herbicide tests.

A. Western White Pine--Previous Tests.

1. Seedlings.

Foliar sprays applied to seedlings 1 month before artificial inoculations show that Phytoactin will provide trees some protection from blister rust infections. Results of foliar sprays applied in 1961 on seedlings indicate that the best Phytoactin treatment tried gave about 30 percent protection after 3 years, with two heavy artificial inoculations given the year of treatment and the following year. Field tests have been established to determine the effectiveness of a single foliar spray treatment over a period of several years under natural rust conditions. Factors that appear to limit long-term protection from a single spray treatment are fungicidal degradation and dilution resulting from tree growth.

Results to date of a 1963 foliar spray test seem to substantiate the conclusion that Phytoactin treatments will provide some protection. Refer to page 18 of the 1963 White Pine Blister Rust Control Report. All treatments in this test, including the controls, are replicated three times in nursery seedling beds. Water was the only carrier used with these materials. Very uniform inoculation has been possible through the use of the large tent inoculation chamber. Murventin (Venturicidin) does not appear to be effective in preventing infections. These seedlings have been inoculated twice--once in 1963 and again in October 1964. The results reported below are from the first inoculation only, and are the averages from all September treatment replications. Other tests seem to indicate that in order to be effective, treatments must be applied after the trees have broken dormancy and recovered from transplanting shock. Treatments applied in June shortly after seedlings were transplanted were not effective. The results reported here are from an examination made in June 1965, before the effects of the second inoculation began to show. Results based on two inoculations will be available in September 1966.

Study trees at the Coeur d'Alene Nursery, Coeur d'Alene National Forest.

Spray treatment	September P.p.m.	Percent seedlings infected
Untreated	--	95.5
Phytoactin	300	90.0
Phytoactin	600	56.8
Phytoactin	1,200	37.4
Murventin	300	100.0
Murventin	600	96.4
Murventin	1,200	96.4

2. 1961 Basal Stem Study.

In June 1961, a basal stem treatment study area of about 2 acres was established to determine the effectiveness of several cycloheximide formulations, the advantage of adding Triton B-1956 to cycloheximide formulations, and the effectiveness of the three Phytoactin formulations.

a. Cycloheximide formulations used were:

(1) Acti-dione BR without Triton B-1956.
(2) Acti-dione 3X.
(3) Naramycin without Triton B-1956.
(4) Naramycin with Triton B-1956.

All cycloheximide solutions were mixed at 150 p.p.m., in No. 1 stove oil.

b. Phytoactin formulations used were:

(1) L-426 at 150 p.p.m.
(2) L-318 at 200 p.p.m.
(3) L-427 at 250 p.p.m.

Phytoactin concentrates were mixed in isopropanol before adding to No. 1 stove oil. All solutions were applied to study trees by the basal stem method. Cankers were not scarified. Thirty 10- to 15-year-old trees with at least one damaging canker[1/] were used as a tree basis.

Annual observations have been made on this study since treatment. Results can be summarized as follows: Cycloheximide formulations with Triton B-1956 were the most effective treatments. Naramycin was comparable to Acti-dione BR in arresting cankers. Acti-dione 3X was comparable to Acti-dione without Triton. Cycloheximide treatments were more effective than Phytoactin treatments. All treatments were more effective on branch cankers than on stem cankers. A correlation exists between canker arrestment and tree

1/ Bole cankers or stem cankers within 12 inches of the bole.

mortality due to the girdling action of stem cankers. Treatments with the highest percentage of cankers arrested have the lowest percentage of trees lost to blister rust. In contrast, treatments with the lowest percentage of cankers arrested showed the highest percentage of trees lost to blister rust. Table 1 shows the breakdown between cankers that were on the bole at the time of treatment and those that were branch cankers at time of treatment, but have since grown to become stem cankers.

3. 1963 Foliar and Basal Stem Study - Clearwater National Forest.

Foliar and basal stem treatments applied to 10- to 20-year-old western white pine in October 1963 were examined in October 1964 and 1965. All bole cankers and branch cankers were classified as alive or arrested, as shown in table 2.

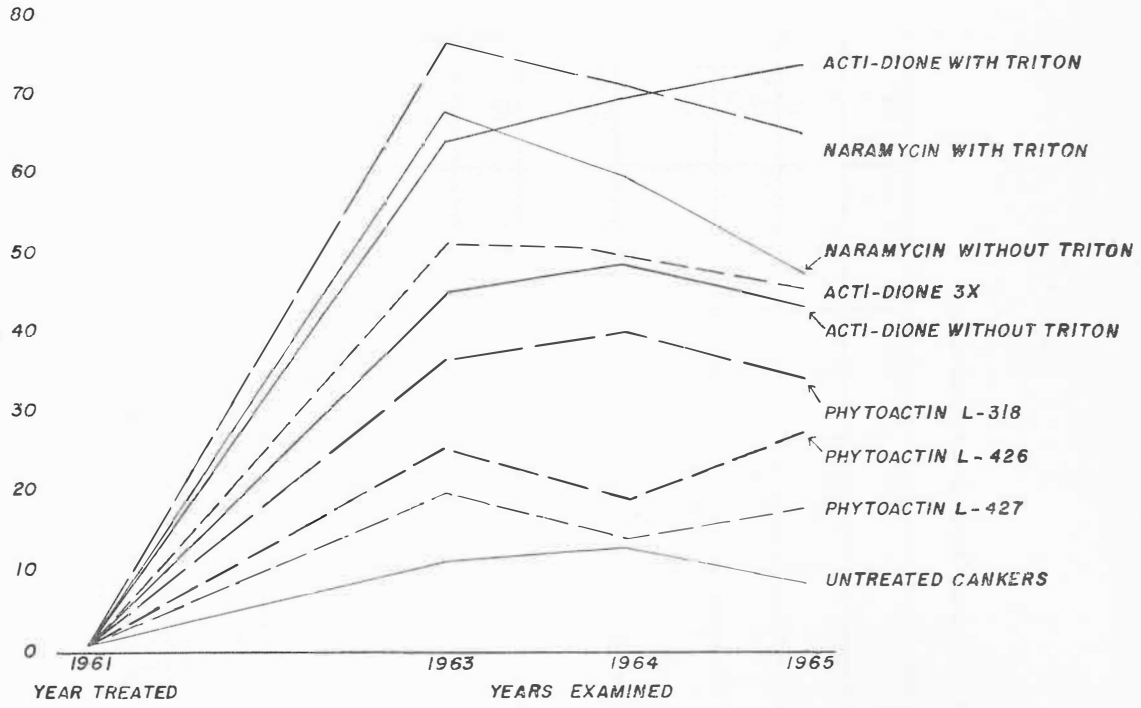
The status of all cankers may not be very meaningful as all arrested branch cankers were on branches that had died back to the stem. The cause of this dieback is not known although some appeared to be due to phytotoxicity. The incidence of Tuberculina maxima sporulation has declined in the two Phytoactin L-440 treatment plots which seem to have the highest degree of treatment effectiveness. Only very few cankers had evidence of T. maxima during all three examinations.

The first foliar application of antibiotic solutions by backpack mistblower to 10- to 20-year-old white pine was made in 1963. The treatments in three blocks of natural pine reproduction were: (a) 20 percent oil in water emulsion control, (b) Phytoactin L-318, 400 p.p.m., 20 percent oil in water emulsion, and (c) Phytoactin L-318, 800 p.p.m., 20 percent oil in water emulsion.

Diseased trees capable of recovery, if the treatment was successful, were selected for study in each test block. Blister rust cankers were examined for disease symptoms and advancement in October 1964 and 1965. Stem encirclement by nongirdling cankers was measured in October 1965. Most of the bole cankers originally selected have since girdled the trees. The three treatments show little difference in average canker extension of the nongirdling cankers remaining (table 3).

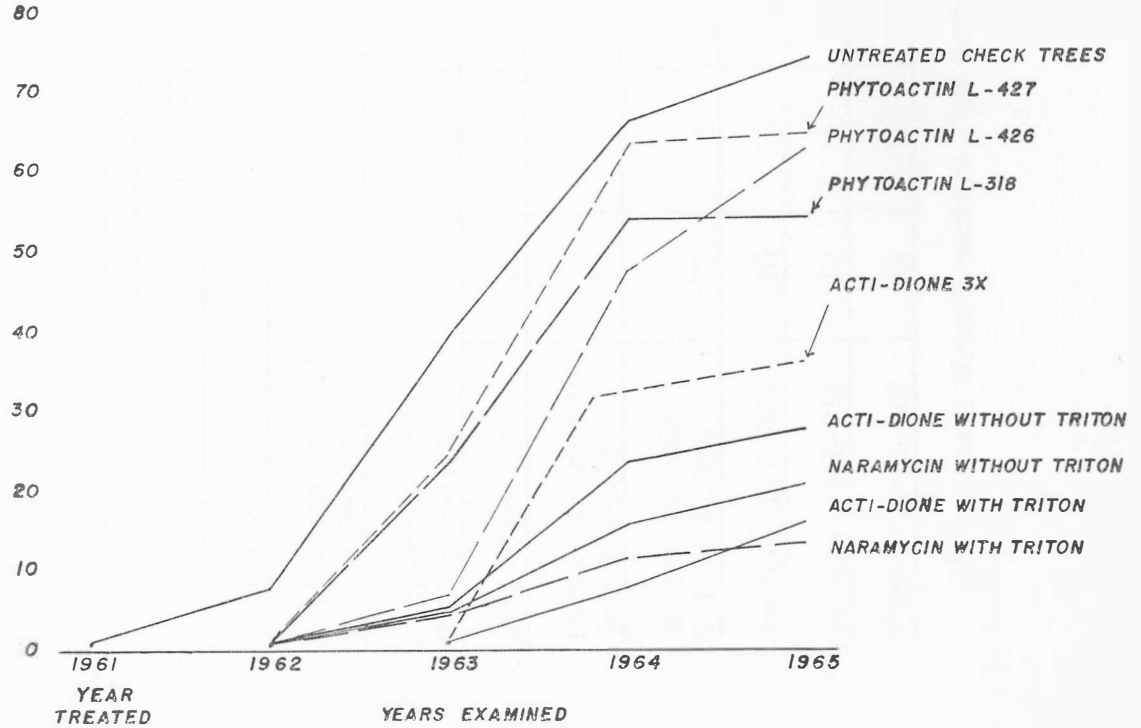
PERCENT OF CANKERS ARRESTED 1/

(FIGURE 1)



PERCENT OF TREES LOST TO BLISTER RUST 2/

(FIGURE 2)



1/ NO LIVE INFECTION SYMPTOMS VISIBLY PRESENT AS DETERMINED BY OBSERVATION

2/ TREES BECOMING GIRDLED SINCE TREATMENT

Table 1.--Canker growth resulting in girdled trees as of 1965

Treatments	Stem cankers			Branch cankers1/			All cankers		
		Girdling tree			Girdling tree			Girdling tree	
	Total	Number	Percent	Total	Number	Percent	Total	Number	Percent
Untreated	17	15	88.2	20	7	35.0	37	22	59.5
Acti-dione without Triton B-1956	12	8	66.6	28	0	0	40	8	20.0
Acti-dione with Triton B-1956	11	1	9.1	21	3	14.3	32	4	12.5
Acti-dione 3X	12	8	66.6	23	2	8.7	35	10	28.5
Naramycin without Triton B-1956	10	4	40.0	29	2	6.9	39	6	15.4
Naramycin with Triton B-1956	12	2	16.6	24	1	4.2	36	3	8.3
Phytoactin L-426	16	15	93.7	22	3	13.6	38	18	47.3
Phytoactin L-318	12	9	75.0	21	6	28.6	33	15	45.5
Phytoactin L-427	14	12	85.7	23	7	30.4	37	19	51.3

1/ Original branch cankers that have become stem cankers since treatment.

Table 2.--Foliar and basal stem treatment of western white pine reproduction, Brown's Creek, Clearwater National Forest

Treatment[1]	Number treated infections	Percent								
		Arrested infections[2]			Infections with T. maxima			Sporulation		
		1964	1965 A	1965 B	1963[3]	1964	1965	1963	1964	1965
No. 1 stove oil only, basal stem	15	0	13	11	38	31	60	0	6	0
Phytoactin L-440 200 p.p.m., in No. 1 stove oil, basal stem	11	21	64	44	64	36	18	0	9	0
Phytoactin L-440 200 p.p.m., light cycle oil,[4] basal stem	13	13	31	27	81	56	38	0	15	0
Murventin, 200 p.p.m., No. 1 stove oil, basal stem	22	0	23	0	22	13	23	0	0	0
Phytoactin L-440 400 p.p.m., in No. 1 stove oil, foliar	22	0	18	0	25	63	36	0	5	0

1/ Five trees in each basal stem treatment, including the stove oil control, were scarified.

2/ Arrested status indicates absence of any disease symptoms or marginal advancement. A = all cankers; B = bole cankers, only.

3/ Incidence recorded at time of treatment.

4/ An oil similar to stove oil but having an aniline point between 90° and 100° F.

An increased number of arrested infections was apparent in 1965 for all treatments. The Phytoactin L-440, in No. 1 stove oil, with stem canker scarification treatment appears to give the best control.

Table 3.--Growth of stem cankers in 1963 foliar treatments between October 1964 and October 1965,[1] Brown's Creek, Clearwater National Forest

Foliar treatment (mistblower)	Number cankers	Average stem diameter at canker center (inches)	Average canker margin extension[2]		Average stem encirclement (percent)
			Inches[3]	Percent[4]	
20 percent oil/ water emulsion control	8	3.97	2.19	17.90	49.05
Phytoactin L-318, 800 p.p.m., 20 percent oil/water emulsion	10	3.70	2.40	20.64	50.83
Phytoactin L-318 400 p.p.m., 20 percent oil/water emulsion	10	3.27	2.47	23.79	60.59

1/ Data selected from those cankers not completely encircling the stem.
2/ Measurable extension of margin of discoloration.
3/ Combined horizontal measurements for both lateral margins.
4/ Horizontal measurements expressed as percentage of stem circumference at canker center.

Table 4.--Total number of cankers recorded by types

Treatment	1963		1965	
	Branch	Stem	Branch	Stem
20 percent oil/water emulsion control	29	11	19	22
Phytoactin L-318, 800 p.p.m., 20 percent oil/water emulsion	23	15	26	26
Phytoactin L-318, 400 p.p.m., 20 percent oil/water emulsion	25	13	22	27

The presence of Tuberculina maxima sporulation on all cankers was recorded in 1964 and 1965 (table 5). Differences in the percent of cankers with T. maxima were greater between the treatments in 1965 than in 1964. The percent of cankers with T. maxima both years (1964 and 1965) was nearly the same for all treatments.

Future evaluations of all mistblower tests are planned.

Table 5.--Incidence of Tuberculina maxima in 1963 mistblower foliar treatments, Brown's Creek, Clearwater National Forest

Treatment	Number trees	Number cankers 1/	Percent cankers with T. maxima sporulation		
			1964	1965	1964 and 1965
20 percent oil/water emulsion control	22	41	67.5	37.5	30.0
Phytoactin L-318, 800 p.p.m., 20 percent oil/water emulsion	25	52	55.8	44.2	28.8
Phytoactin L-318, 400 p.p.m., 20 percent oil/water emulsion	32	49	65.3	55.1	32.7

1/ Both bole and branch cankers.

4. Aerial Application.

Aerially sprayed and untreated control plots established in 1960 and 1961 were reexamined in 1965. By and large, the percent of live and arrested cankers was not significantly different from that determined in the 1964 examinations. Differences in the number of trees lost from blister rust are becoming greater between most sprayed and unsprayed plots each year. In one Forest for example, the number of trees lost from blister rust is nearly four times greater in an unsprayed plot than in one of the sprayed plots. Since only a spring examination was possible during 1965, results are not reported. An examination during both seasons will be made in 1966.

The low-volume 1-gallon per acre aerial test plots sprayed in June 1964, Coeur d'Alene National Forest, are scheduled for the first evaluation in 1966. The test includes four 40-acre plots. One each of three plots was sprayed with formulations of Phytoactin: (a) L-318 mixed as an emulsion in 50 percent No. 1 fuel oil, (b) L-488 in 100 percent No. 1 fuel oil, and (c) L-489 in 100 percent No. 1 fuel oil. The fourth plot is an unsprayed control. Twenty trees with healthy, vigorous infections in each plot were selected and marked for study.

B. Western White Pine--New Tests.

1. Antibiotic Protective Study.

An extensive field study replicated on five National Forests was established in 1965. Its purpose is to determine protective and eradicative capabilities of several antibiotic treatments under field conditions on two age classes, 2-0 seedlings and 5- to 10-year-old reproduction.

a. Five outplantings were established throughout the white pine region. Each outplanting consisted of 16 blocks of 100 uninfected seedlings. A Latin square design was used to replicate four treatments:

(1) Phytoactin, 100 mg. tablet.

(2) Phytoactin, 200 p.p.m., 20 percent oil emulsion foliar spray.

(3) Phleomycin, 100 p.p.m., 20 percent oil emulsion foliar spray.

(4) Untreated seedlings.

b. Four areas, outside ribes eradication units and distributed throughout the Region, were selected for testing various treatments on 5- to 10-year-old trees. All white pine within each block were staked and examined for rust before treatment. Ribes and pine locations were plotted on data sheets. Blister rust infection averaged 14.0 percent. Treatments replicated in blocks were:

(1) Phleomycin, 100 p.p.m., 20 percent oil emulsion foliar spray.

(2) Phytoactin, 200 p.p.m., 20 percent oil emulsion foliar spray.

(3) Phytoactin L-440, 400 p.p.m., mistblower application.

(4) Acti-dione, 150 p.p.m., plus Triton B-1956 in 100 percent oil, basal stem treatment.

(5) Untreated trees.

Rust information will be taken annually on both outplantings and reproduction in an effort to determine protective and eradicative effectiveness.

2. Root Absorption Study.

Nine purified antibiotics were formulated in 100 p.p.m., aqueous solutions and applied as root treatments to 2-0 seedlings in May 1965. The antibiotics were:

a. Stendomycin.
b. Vancomycin.
c. Phleomycin.
d. Griseofulvin.
e. Endomycin.
f. Anisomycin.

g. Rinocidin.
h. Oligomycin.
i. Cycloheximide oxime at 10 p.p.m., was also included.

Seedling roots were submerged in the solutions for 48 hours to allow antibiotic uptake. Following treatment, seedlings were planted in randomized blocks of 13 trees each, replicated six times. This included six untreated blocks with 13 trees each to serve as checks.

Cycloheximide oxime treatments caused heavy mortality. Almost all the seedlings were dead when examined in September 1965. Anisomycin treatments caused about 50 percent mortality. No other treatment has shown phytotoxicity to date. All seedlings were artificially inoculated in September 1965 and will be examined each year for the next several years to determine protective effects.

3. Seedling Physiology Study.

So far, the only promising seedling antibiotic treatment has been a foliar spray applied during the fall period on seedlings transplanted during early spring. To determine if tree physiology affects treatment results, white pine seedlings, planted in May 1964, were foliar treated with Phytoactin and Phleomycin in the spring of 1965. Treatments were applied during three growth periods: (a) in March when trees were dormant, (b) in April when buds were starting to elongate, and (c) in June when candle growth was fully developed. Formulations used were: (a) Phytoactin L-318, 200 p.p.m., (b) Phleomycin, 200 p.p.m., and (c) Triton X-115, 0.1 percent, control. Treatment blocks of 13 trees each are replicated six times. Six blocks of 13 trees each were left untreated for checks. All seedlings were artificially inoculated in September 1965 and will be examined each year for the next several years. If some effectiveness is shown, the trees will be inoculated again.

4. Spray Carrier Study.

Antibiotic formulations mixed in oil-water emulsions and oil carriers were sprayed on 2-1 seedlings in August 1965. Phytoactin L-318 and Phleomycin at 200 p.p.m., were diluted in 10 percent fuel oil-water emulsions. Distilled water was used. Both solutions had a pH of 4.6. Phytoactin L-318 was also mixed in hard tapwater and 10 percent fuel oil. This solution had a pH of 7.4. Acti-dione BR and Phytoactin L-440 were diluted in 100 percent stove oil and applied by both basal stem and foliar spray methods. Acti-dione was mixed at 100 p.p.m. for basal stem sprays and at 10 p.p.m. for foliar sprays. Phytoactin L-440 was applied at 200 p.p.m. for both basal stem and foliar sprays. A 20 percent oil emulsion applied as a foliar spray, pure oil applied as a basal stem spray, and

untreated trees are included as controls. Each treatment and the controls were replicated six times in blocks of 13 seedlings each. All seedlings will be artificially inoculated in September 1966.

5. Artificial Inoculations.

Inoculation techniques were modified in 1965. Instead of placing ribes stems in the ground directly over the seedlings, ribes branches were hung on four overhead lines 5 feet above the seedlings. This change should improve spore distribution throughout the inoculation chamber. Reduction in both number of ribes branches and duration of inoculation period (from 72 to 48 hours) were other changes made this year.

A better and more manageable field inoculation technique that is very reliable if favorable weather conditions prevail during the inoculation period has been worked out. The original method, described by E. Hubert, used a celluloid cyclinder to serve as a humidity chamber. The cylinder was slipped over several branches and the two open ends were plugged with wet cotton after the inoculum was placed inside. Our new technique substitutes large polythylene bags for the celluloid cylinders. After the ribes leaves have been tied to the pine branches they are wet down with water. The polyethylene bag is then slipped over the branches, secured with twist-on tape, and left for 72 hours. Difficulties in maintaining high humidity have been overcome by using polyethylene bags. Although aluminum foil covers can be used to guard against high temperatures during sunny periods, inoculations should be made under a cloud cover.

6. Foliar Treatments on Grafted Stock, Clearwater National Forest.

A statistically designed study of chemicals in blister rust prevention on three age classes of pine was started in 1965. The degree and duration of protection provided by three treatments will be tested by artificial inoculation. Samples from three age classes are being concentrated in a test block approximately 1/2-chain wide and 1 chain long. Individuals representing the three age classes are being brought together by using grafts.

Scions cut (March 1965) from the ends of branches of trees in 10- to 20-, 40- to 60-, and 80- to 100-year-old age groups were grafted to 10- to 15-year-old pine rootstock in May 1965. An examination (October 1965) showed at least one live scion on 82.6 percent, 76.9 percent, and 77.8 percent of the reproduction (10-20 years), pole (40-60 years), and mature (80-100 years) scions, respectively. Regrafting and completion of ungrafted rootstock are planned for May 1966.

After two seasons to allow for scion adjustment and growth, these trees will be randomly assigned to two foliar treatments and an untreated check. The scions will be inoculated under controlled conditions 1 year after treatment. Results will be analyzed to determine effects of tree age and the two treatments.

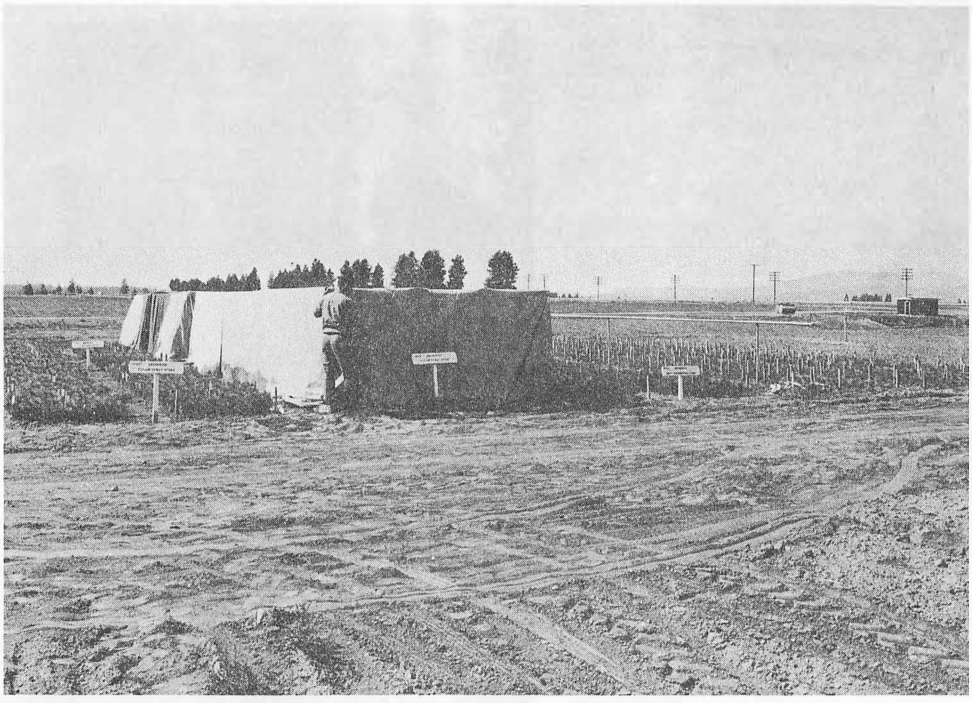
7. Penetration Study.

Tests to measure penetrating ability of various organic solvents started in 1964 were continued in 1965. These solvents are being added to antibiotic solutions in an effort to increase penetration. Distilled water solutions of purified dry-form Phytoactin and Phleomycin with various solvents were applied to groups of five trees each with a Solo mistblower as follows:

Antibiotic 1/	Chemical additive and concentration
Phytoactin	Dimethyl sulfoxide (DMSO), 0.5 percent
	DMSO, 1 percent
	DMSO, 2 percent
	Pine oil, 1 percent
	Pine oil, 2 percent
	Dowanol, 1 percent
	DMSO, Dowanol, pine oil, 1 percent each
	Ethyl methyl ketone, 1 percent
	Alpha-napthaleneacetic acid, 50 p.p.m.
	Gibberellic acid, 100 p.p.m.
	Glycerine, 1 percent
	Indole-3-acetic acid (IAA), 50 p.p.m.
	Gibberellic acid and IAA, 100 and 50 p.p.m., respectively
	Triton X-114, 1 percent
	Triton X-800, 1 percent
	Triton X-207, 1 percent
	Volk Supreme spray oil, 1 percent
	Aroclor, 1 percent
	Linseed oil, 1 percent
	Plyac, 1 percent
	None
Phleomycin	DMSO, 0.5 percent
	DMSO, 1 percent
	DMSO, 2 percent
	Pine oil, 1 percent
	Dowanol, 1 percent
	DMSO, Dowanol, pine oil, 1 percent each
	Glycerine, 1 percent
	Plyac, 1 percent
	Aroclor, 1 percent
	None
None	None (untreated checks)

1/ Antibiotic concentration is 150 p.p.m.

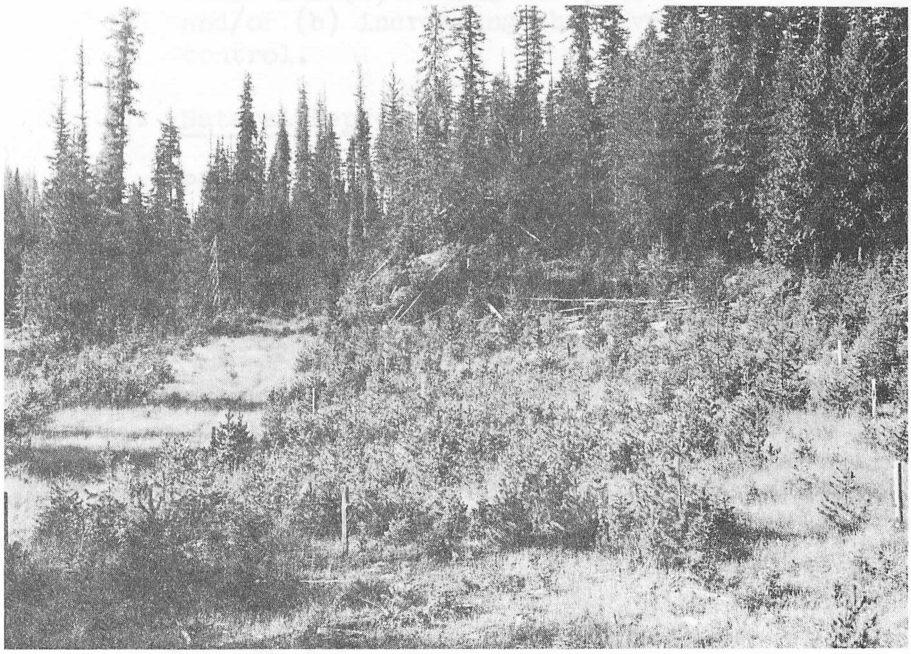
Other trees in the same test area were treated with No. 1 stove oil solutions containing different oil soluble formulations of Phytoactin. Also included were Phytoactin L-440 solutions with DMSO, Dowanol, and pine oil added. DMSO and Dowanol, although only slightly soluble in No. 1 stove oil, can be dissolved as a



Artificial inoculation chambers at the Coeur d'Alene Nursery.

Inside view of artificial inoculation chamber showing method of ribes placement. Ribes are attached to overhead lines with clothespins. Slides for spore count determinations are on top of the stakes.

Left.--A live and growing scion 2-1/2 months after grafting to rootstock. Arrow indicates graft between scion and rootstock still wound with tape.



Overall view of 10- to 15-year-old western white pine regeneration used as rootstock in protection study. Area has been fenced.

1 percent concentration in a phytoactin L-440 (400 p.p.m., or higher) stove oil solution. The various solutions applied to groups of five trees each with a Solo mistblower were as follows:

Formulation number	Antibiotic concentration (p.p.m.)	Solution additive and concentration
L-548	1,000	None
L-549	1,000	None
L-550	1,000	None
L-551	1,000	None
L-552	1,000	None
L-553	1,000	None
L-440	1,000	None
L-440	1,000	DMSO, 1 percent
L-440	1,000	DMSO, 2 percent
L-440	1,000	Dowanol, 1 percent
L-440	1,000	Pine oil, 1 percent
L-440	1,000	DMSO, Dowanol, pine oil, 1 percent each
L-440	500	DMSO, 1 percent
Control-treated	0	DMSO, 1 percent and pine oil, 6 percent
Control-untreated	0	None

Comparative evaluations will be made from laboratory analyses of needle extracts and incidence of artificially induced infections.

Many of these chemicals have been reported in pathological literature for (a) aiding the penetration of solutions into leaves and/or (b) increasing the level of some specific plant disease control.

8. Natural Reproduction--Aerial Spray, Clearwater National Forest.

Plots of natural reproduction, 10- to 15-years-old, were aerially sprayed during June with a helicopter. Plot size was 10 acres. Two Phytoactin formulations with different carriers, additives, and dosage rates were used as follows:

Table 6.--Helicopter application of Phytoactin to 10- to 15-year-old reproduction, Dewey Creek, Clearwater National Forest

Antibiotic formulation	Antibiotic concentration (p.p.m.)	Carrier	Additive 1/	Gallons per acre	Number plots	Number study trees
L-440	570	No. 1 stove oil	Pine oil and DMSO	3.5	2	62
L-318	200	20 percent No. 1 stove oil-water emulsion	Pine oil	7.5	2	70
Control	0	None	None	0	2	33

1/ Each material was added in a 1 percent concentration by volume.

Infected trees capable of recovery by a successful treatment were selected for study. Needles collected from treated and untreated trees will be quantitatively analyzed for Phytoactin in the laboratory. These results, in addition to infection examinations, will be used to evaluate treatments.

9. Plantation--Low volume Aerial Spray, Coeur d'Alene National Forest.

In October 1965, Phytoactin L-544, an L-440 product modified for use at the 2 gallons per acre rate, was applied to four 40-acre plots. Two of these plots were sprayed with nozzles that gave a much smaller droplet size than that currently being used. The Missoula Equipment Development Center furnished the technical assistance for this part of the test. Additional plots include two unsprayed checks and two sprayed with the L-318 formulation mixed as a 20 percent oil emulsion and applied at the 7 gallons per acre rate. Dosage rate for all plots was 7.5 grams of active material per acre. The L-544 formulation was diluted in No. 1 fuel oil. Study area tree selection, plot boundary establishment, and the spraying were done by the Coeur d'Alene National Forest. Treatments are scheduled to be evaluated after the second growing season.

C. Whitebark Pine--Previous Tests.

A few of the whitebark pine plots sprayed with antibiotics in 1961 and 1962 at Hudson Bay Divide were examined in July. No differences between treated and untreated cankers were observed. The whitebark plots sprayed in 1963 were examined in June. Aecia production differed between treatments as follows:

Table 7.--Incidence of aecia on whitebark pine cankers during the second aecial period following treatment

Treatment 1/	Percent cankers producing aecia	Total cankers (number)
None - unsprayed checks	81	30
Light cycle oil foliar control	46	24
No. 1 stove oil foliar control	67	18
Light cycle oil basal stem control	45	31
No. 1 stove oil basal stem control	72	29
Phytoactin L-440, 200 p.p.m., light cycle oil, basal stem	44	25
Phytoactin L-440, 200 p.p.m., No. 1 stove oil, basal stem	64	26
Phytoactin L-440, 200 p.p.m., light cycle oil, foliar	77	13
Phytoactin L-440, 200 p.p.m., No. 1 stove oil, foliar	66	25

1/ One-half of the trees in the basal stem treatments, including unsprayed checks, were scarified. No antibiotic was present in any of the oil control treatments.

Light cycle oil and No. 1 stove oil alone suppressed aecia production during the second growing season following treatment. The light cycle oil had a consistently greater effect than the No. 1 stove oil in each pair of treatments with one exception. The Phytoactin L-440 light cycle oil-foliar treatment resulted in a higher percentage of cankers producing aecia than the Phytoactin L-440 No. 1 stove oil-foliar treatment and the light cycle oil-foliar control. Natural biological development and other variables may explain this. A complete examination will be made in 1966.

D. Whitebark Pines--New Tests.

Previous tests have not produced a successful treatment for whitebark or limber pine. Several additional antibiotics, conventional fungicides, growth regulators, and other chemicals were applied to test trees as direct canker treatment (table 8). Some of the materials used have shown promise in controlling blister rust cankers on sugar pine.2/ Each solution was applied to groups of five trees having stem cankers and branch cankers with advancing margins within 4 inches of the stem. The slit method consisted of slitting the discolored margin and adjacent green bark in several places with a hatchet and then spraying to the point of runoff. The excise method consisted of removing all diseased tissue as evidence by discoloration and then spraying to the point of runoff. The four principal canker apexes were marked with pins for future reference. Treatments showing effects on disease symptoms will be repeated.

E. 1964 Herbicide Test Results.

Tordon 10K (4-amino-3,5,6-trichloropicolinic acid as the potassium salt) and Dybar (3-phenyl-1,1-dimethylurea) both in pellet form applied to the soil surface around root crowns of 6- to 8-year-old Ribes viscosissimum and lacustre killed in excess of 90 percent of the plants.

Tordon and Dybar phytotoxicity differed in the way each chemical visually affected the leaves of intact plants and the growth habit of subsequent resprouts. Tordon action induced leaf necrosis almost simultaneously; i.e., all parts of a leaf turned brown at the same time; whereas, Dybar characteristically killed only the leaf margins of the intact plants. The residual ribes in the two treatment areas mainly varied in the number, vigor, and origin of resprouts per plant. The residual ribes in the Tordon area were resprouting almost exclusively from the root crowns. The residual ribes in the Dybar area were resprouting both from root crowns and stems. The two treatments further differed in the number and vigor of resprouts per residual ribes plant. Resprouts were fewer in number per plant and their vigor appeared lower in the Tordon treatment. Residual ribes with the weakest resprouts possibly will succumb before the next inspection. The 2-year after-treatment inspection is scheduled for 1966.

F. 1965 Herbicide Tests.

Two new products, Ansar 529 (monosodium acid methanearsonate) and Ansar 560 (sodium cacodylate) were tested on upland ribes in a clearcut block in the Blacktail Creek drainage on the Kaniksu National Forest. Ansar 529 is a 34.3 percent solution of monosodium acid

2/ Quick, Clarence R. Experimental fungicidal control of blister rust on sugar pine in California. U.S. For. Serv., Res. Note PSW-48, 1964.

Table 8.--Direct canker treatments to eradicate blister rust infections on whitebark pine

Test compound	Solution concentration		Carrier	Treatment method
	P.p.m.	Percent		
None - treated controls	0	0	Water	Slit[1/]
None - treated controls	0	0	Water	Excise[2/]
Antibiotics:				
Phytoactin powder	150	--	Water	Slit
Phytoactin powder	150	--	Sovaspray 100	Slit
Phytoactin L-440 plus DMSO, 1 percent	400	--	No. 1 stove oil	Slit
Cycloheximide BR concentrate	200	--	No. 1 stove oil	Slit
Cycloheximide powder	150	--	Water	Slit
Acti-dione BR aerosol	300	--	No. 1 stove oil	Slit
Cycloheximide powder	150	--	Water	Excise
Cycloheximide powder	150	--	Sovaspray 100	Excise
Vancomycin powder	150	--	Water	Slit
Endomycin powder	150	--	Water	Slit
Stendomycin powder	150	--	Water	Slit
Griseofulvin powder	150	--	Water	Slit
Agrimycin powder:				
Streptomycin)	150	--	Water	Slit
Terramycin)	15			
Phleomycin powder	150	--	Water	Slit
Conventional Fungicides:				
Terraclor	--	1	Water	Slit
Terraclor	--	1	Sovaspray 100	Slit
Captan	--	1	Water	Slit
Dowicide I	--	1	No. 1 stove oil	Slit
Growth Regulators:				
2,4,5 - TPA[3/]	2,000	--	Water	Slit
2,4,5 - TBA[4/]	2,000	--	Water	Slit
2,4,-D and 2,4,5-T (1:1)	2,000	--	Water	Slit
Maleic hydrazide	2,000	--	Water	Slit
Miscellaneous:				
Benzoic acid	--	1	Water	Slit
Calcium sulfamate	--	1	Water	Slit

1/ Marginal canker slits.
2/ Diseased tissue excision.
3/ Trichlorophenoxyacetic acid.
4/ Trichlorophenoxybutyric acid.

methanearsonate (MSMA) by weight. One gallon of the concentrate contains 3.96 pounds of MSMA and is equivalent to 7.20 pounds of disodium methanearsonate hexahydrate (DSMA) per gallon. Ansar 560 is a 22.6 percent solution of sodium cacodylate by weight. The concentrate contains the equivalent of 2.48 pounds of dimethylarsinic acid (cacodylic acid) per gallon. The outstanding characterisitics claimed for these two materials are their relatively low order of mammalian toxicity, fast action, low cost, and lack of residual phytotoxicity in the soil. Samples for the tests were supplied by the Ansul Company, Marinette, Wisconsin.

One 1/4-acre plot each was sprayed with Ansar 529 and Ansar 560. The concentrates, containing a surfactant, were diluted in water. Volume dilution rates recommended for noncrop areas by the manufacturer were used as follows: (1) Ansar 529--1 part to 80 parts water, and (2) Ansar 560--1 part to 50 parts water. The final solution mixtures were applied with a Dobbins pressure sprayer, first to the root crowns as a soil drench and then to the ribes foliage. Both leaf surfaces and all stems were generously wet with spray solution. Ribes viscosissimum was the principal species with a few R. lacustre plants scattered in each plot. Spray solution was applied while plants were still in active growth during early August. The two treatments will be evaluated in 1966.

G. Cooperation.

Research in bioassay methods and in the identification of the physical and chemical properties of Phytoactin extracted from western white pine tissues was continued in cooperation with P-L Biochemicals, Inc., Milwaukee, Wisconsin; Washington State University, Department of Plant Pathology; and the Intermountain Forest and Range Experiment Station. A new project using gas chromatography to determine concentration levels of fuel oil in western white pine foliage was started in 1965. The purpose of this project is to develop (1) a method to more accurately measure spray coverage, and (2) a procedure to more rapidly determine Phytoactin quantities in western white pine foliage. Trees were ground-foliar sprayed with Phytoactin L-544 diluted in No. 1 fuel oil. Foliage samples were collected 2 hours, 2 days, 1 week, 2 weeks, 1 month, and 2 months after spraying. Development of the fuel oil extraction procedure and the gas chromatography method was arranged by P-L Biochemicals, Inc. Results to date are as follows:

Table 9.--Gas chromatography analyses

Sample numbers	Treatment	Fuel oil analyses (p.p.m.) after the indicated times				
		2 hours	2 days	1 week	2 weeks	1 month
1 + 5 + 6	None (controls)	<10 1/	<10 1/	<10 1/	<10 1/	<10 1/
4 + 8	Phytoactin L-544	1,500	100	110	39	20
2 + 3 + 7	Phytoactin L-544	1,300	100	45	63	50

1/ 10 p.p.m. was the minimum amount of fuel oil that could be accurately measured by the methods used.

III. DEVELOPMENT OF RUST RESISTANT WHITE PINE

Nineteen hundred and sixty-five was the 16th year of cooperative work in the Region 1-Intermountain Station program for developing rust resistant western white pine (see figure 8, page 56 of the 1964 report).

The second step (test-crossing of 400 rust-free candidate trees) in the long breeding job was almost completed, with test-cross progenies of the last 40 candidates being sown in December in the Moscow rust resistance progeny test nursery. Under step 3 (reselection of candidates for general combining ability in transmitting resistance), we now recognize 42 candidates as general combiners with high breeding value. Another 19 candidates are tentatively identified. Under step 4 (remating general combiners within elevational zones) we have so far remated three pairs of low-elevation trees, 8 mid- and 1 high-elevation pair. Work on step 5, (sowing, inoculation, and selection of survivors from step 4 rematings) will commence in 1966.

Supporting research work on several long-term studies continues.

IV. BIOLOGICAL AND CHEMICAL WHITE PINE BLISTER RUST CONTROL RESEARCH

Two experiments, previously unreported in the annual reports, have been installed by the Intermountain Station and the Region near Headquarters, Idaho, on land owned by Potlatch Forests, Inc. These cooperative studies are a part of a larger program by the Forest Service to test the effectiveness of Acti-dione BR and Phytoactin in controlling blister rust on eastern white, sugar, and western white pines. One experiment is designed to evaluate basal stem treatments with Acti-dione and Phytoactin, and the other to evaluate aerial treatment with Phytoactin.

Methods

The treatment procedures, formulations, and materials were like those that have been used on the Region's control projects. Applications were made by regional personnel with help and guidance from people in Forest Disease Research at the Forestry Sciences Laboratory in Moscow. Trees and cankers were selected on much the same basis used in the Region's evaluation strips, except some intermediate trees were included in samples for the aerial study.

Data were recorded on study cankers and trees immediately after treatment and in each subsequent year. These data included the usual tree measurements and observations and/or measurements on fruiting by the blister rust fungus, current fruiting of Tuberculina maxima, and other fungi present on cankers, canker growth, discoloration, rodent chewing, and inactivity along canker margins. Cankers were judged to be either active or inactive; an inactive canker had no macroscopic symptoms or signs of the disease. No cankers were judged to be dead because no procedure has been developed to determine death of the fungus in a canker, other than continued inactivity over more than just 2 years.

Basal stem treatments were applied in late June and early July 1963, and the results reported here were recorded from two successive observations made in 1965. The treatments were:

1. No treatment.

2. Scarification only.

3. Scarification plus western fuel oil No. 1.

4. Scarification plus western fuel oil No. 1 plus surfactant (surfactant was Triton B-1956).

5. Scarification plus western fuel oil No. 1 plus surfactant plus Acti-dione BR (Acti-dione at 150 p.p.m. final solution).

6. Scarification plus western fuel oil No. 1 plus Phytoactin (Phytoactin L-440 at 200 p.p.m. final solution).

A total of 510 trees were used in the study. Treatments were applied randomly within each successive group of six trees. There were one or, occasionally, two cankers per tree per treatment.

Aerial treatments were applied in mid-May 1964, and the results were from one observation made in late June 1965. Treatments were:

1. No treatment.

2. 20 percent western fuel oil No. 1 and water emulsion plus surfactant (surfactant was Multi-film L at 0.57 ounce per gallon of water).

3. 20 percent oil-water emulsion plus surfactant plus Phytoactin (Phytoactin L-318 at 7.5 grams per acre).

Four plots, from a total of 12, were randomly selected for each treatment. The plots in treatment 2 were treated before the ones in treatment 3. Forty-four trees, each with one or up to four suitable cankers, were selected for study on each plot.

Results

The pertinent data are summarized in table 10 for the 1965 observations, 1 and 2 years following the aerial and the basal stem treatments, respectively. The data are reported on a canker rather than tree basis because it is too soon to predict whether an inactive canker will remain inactive.

Only the basal stem treatment that included Acti-dione had a significant effect on canker activity, but the level of inactivation (45 percent) seems lower than would be expected. Treatments that had Phytoactin as one ingredient did not significantly alter canker activity. Except where there are significant differences in the level of canker inactivation between treatments, the evaluations to be made in 1966 should provide sufficient data for reasonable interpretation of the effectiveness of treatments. If a significant number of cankers in any one treatment should then be inactive, they will be kept under observation to determine their destiny.

Table 10.--Results from evaluations of aerial and basal stem treatments, Intermountain Forest and Range Experiment Station

Treatment	Cankers		Trees	
	Total1/ (number)	Inactive (percent)	Total (number)	Dead (percent)
Aerial:				
Untreated	193	5	176	2
Oil emulsion plus surfactant	191	12	176	6
Oil emulsion plus surfactant plus Phytoactin	201	5	176	4
Basal Stem:				
Untreated	86	0	86	0
Scarification only	89	0	86	0
Scarification plus oil	88	3	86	0
Scarification plus oil plus surfactant	86	1	86	0
Scarification plus oil plus Phytoactin	86	3	86	1
Scarification plus oil plus surfactant plus Acti-dione BR	89	45	86	7

1/ Includes one canker, recorded as active, for each dead tree.

V. MECHANICAL DEVELOPMENT AND IMPROVEMENT FOR WHITE PINE BLISTER RUST CONTROL

A. Swiss Tree Gripper.

Drawings (page 93 of the Blister Rust Control Handbook, FSH 5277 R-1 Chapter 120) and an English translation of the instructions for using these mechanical tree climbers were made available to all field units.

B. New Parts Numbers for Hudson Sprayers.

Illustrative drawings (pages 23, 23a, and 23b in the Blister Rust Control Handbook, FSH 5277 R-1 Chapter 120) were provided for ordering replacement parts for hand sprayers.

C. Incisors That Open Tree Bark and Fill Cut in Single Stroke.

1. The illustration (figure 3) shows a hand tool made by the Ansul Company. In reply to our inquiry this company sent a picture of the tool, saying that it was available for tests. Later, because of mechanical difficulties in the initial trial units, the company stated that field trials will be postponed until further improvements can be made. No tools were received for observation.

2. Because a need exists for this type of tool, the three hatchets shown in the top section of the illustration were designed and fabricated to automatically inject fluid into incisions. When in use these tools are attached with a short oil-proof hose to a pressure tank mounted on a backpack frame.

   The bantam weight hatchet, using the weight-actuated Falcon Valve, appears to be the best tool. The weight pops the valve open for an instant and discharges liquid into the cut from both sides of the blade. A built-in spring returns the valve to off position. Amount of fluid can be regulated by size of openings at outlet. These tools will be used experimentally for scarifying blister rust cankers, and they may also have other tree injection uses.

D. Aerial Spray Equipment Maintenance.

There were six 2,000-gallon mixing tankers and three 900-gallon truck slip-on tanks, steam cleaned, sand blasted, and coated with an epoxy resin on inside surfaces.

Three coats were applied to the mixing tankers and two to the slip-on tanks.

These treatments will prevent rust and contamination during storage periods, and make them more easily maintained.

E. Audio/Visual Display.

The illustration (figure 4) is of a display case using nine 11- by 14-inch pictures to depict blister rust control activities. This display is designed for use in public and utility buildings, and Supervisor and Ranger District Offices', but it can be used almost anywhere. The Clearwater and Coeur d'Alene Forests provided much of the talent and materials. Additional cases will be constructed during 1966.

The pictures are first printed in black and white translight film and then hand painted with oils.

Pictures are set between a plate glass front and a plastic diffusion sheet.

The 9-inch deep case is lighted with four 72-inch fluorescent lamps. Light comes through a frosted white plastic face. Transparent glide tracks to hold the pictures are mounted on this plastic face. Captions (black letters on transparent plastic) are separate slides. A set of pictures and captions can be exchanged for a different set on another subject within 15 minutes. Special features of the display case:

1. A regular toggle switch, and a pushbutton timer that may be set from 2 to 7 minutes.

2. The case may stand on its four tapered steel legs, sit on a table, or be hung on wall brackets.

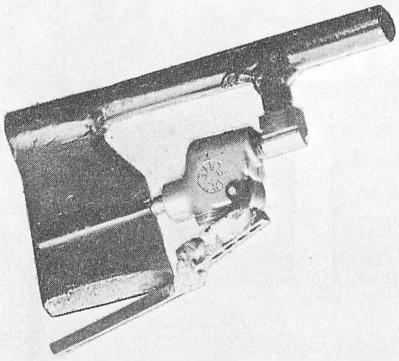
3. A waterproof, three-wire, 50-foot extension cord is provided.

4. The case is vented and a small squirrel-cage fan exhausts any heat generated by the ballasts operating the fluorescent lamps.

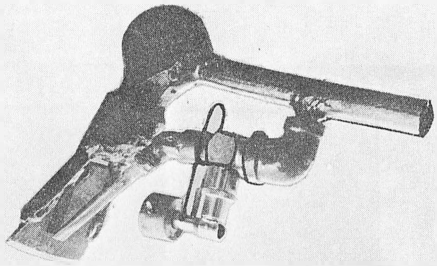
5. An accessory case holds two sets of pictures, the top subject box, a strap wrench for setting the steel legs into their base anchorage, four tapered legs, and a bottle of alcohol for cleaning smudges from the plastic.

6. A transport box with reinforced corners and trunk lifting handles is provided for shipping.

INCISORS THAT OPEN TREE BARK AND FILL CUT IN SINGLE STROKE

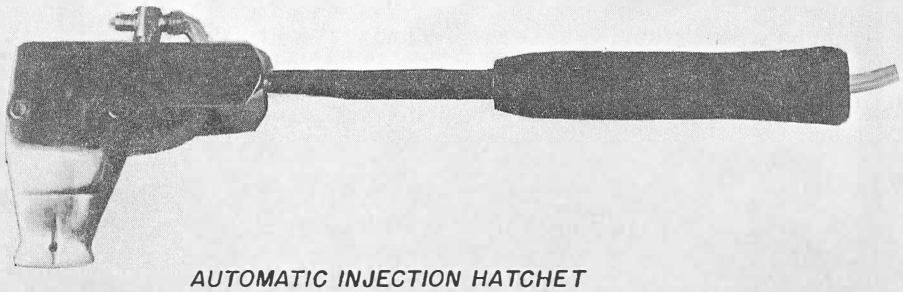


HATCHET EMPLOYS TREE CONTACT LEVER TO RELEASE FLUID



ADZ SHAPED HATCHET WITH LIQUID RELEASE BY WEIGHT ACTUATED FALCON VALVE

BANTAM WEIGHT HATCHET USING FALCON VALVE



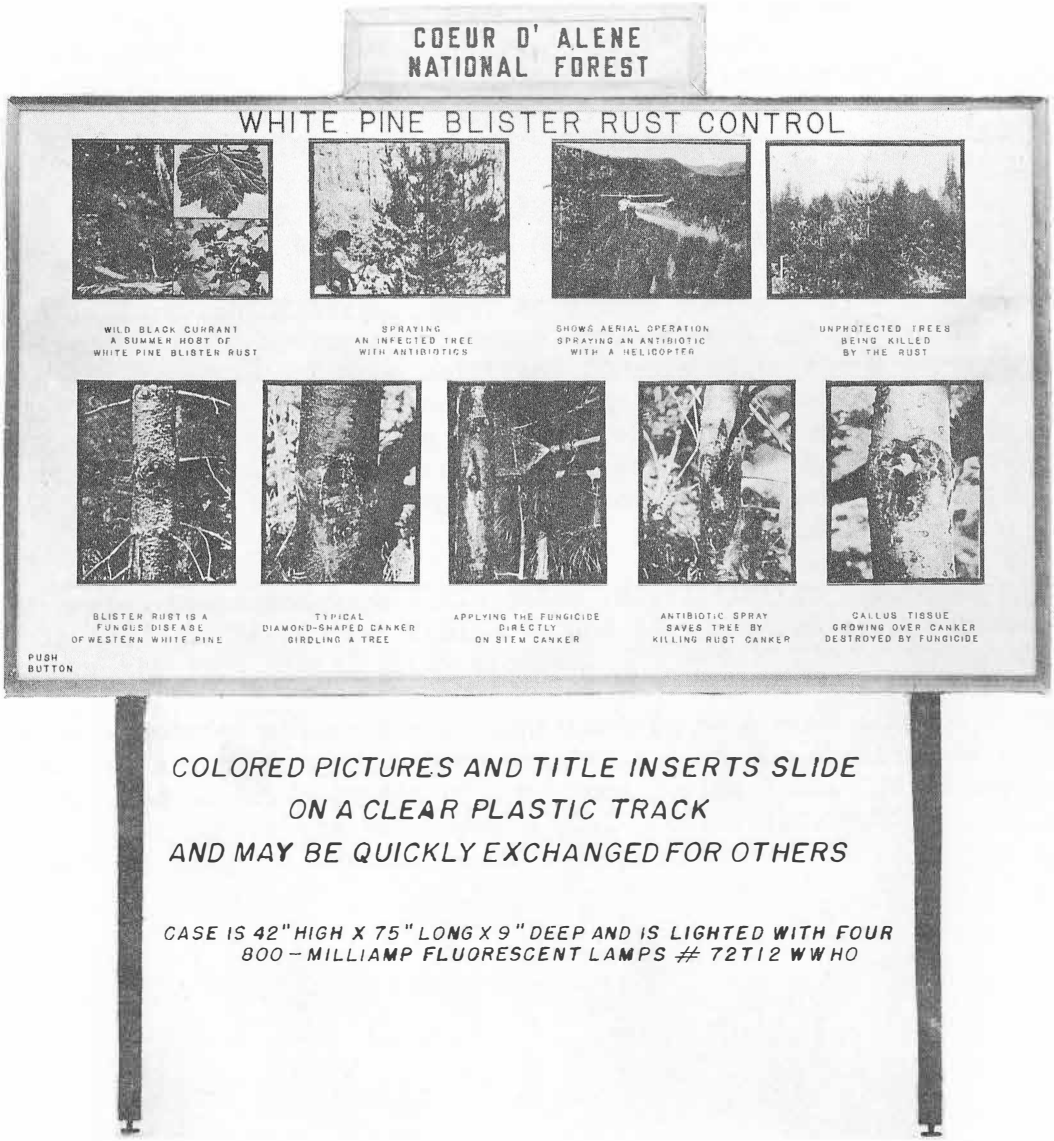
AUTOMATIC INJECTION HATCHET
CHEMICAL PRODUCTS DIVISION
Ansul Company – Marinette, Wis.

Note – See text regarding above experimental tool

Figure 3

DISPLAY CASE

FEATURING TINTED PICTURES ON
TRANSLITE PHOTOGRAPHIC PLASTIC FILM
THE 11" x 14" COPIES OF COLORED SLIDES ARE HAND PAINTED IN
OILS AND DISPLAYED ON A BACK LIGHTED
FROSTED WHITE PLASTIC FACE BOARD



COLORED PICTURES AND TITLE INSERTS SLIDE
ON A CLEAR PLASTIC TRACK
AND MAY BE QUICKLY EXCHANGED FOR OTHERS

CASE IS 42" HIGH X 75" LONG X 9" DEEP AND IS LIGHTED WITH FOUR
800 – MILLIAMP FLUORESCENT LAMPS # 72T12 WWHO

FOUR TAPERED STEEL LEGS — 7" CENTERS AT TOP
1-3/8" TOP X 3/4" BOTTOM — 15" CENTERS AT FLOOR LINE
LEGS ARE 28" LONG AND ARE SET IN BASE OF CASE WITH 9/16" USFT
HEAD PIN

Figure 4

VI. AERIAL APPLICATION OF ANTIBIOTICS

All aerial spraying in 1965 was done with helicopters using the standard formulation of Phytoactin L-318 emulsified with Multi-film L in an 80 percent water and 20 percent No. 1 fuel oil solution. Spraying was done at the rate of 7 gallons with 7.5 grams of Phytoactin L-318 per acre.

Thirteen helicopters contracted from the following firms were used during the spring and fall spray seasons:

Empire Helicopters, Inc., Spokane, Washington - 1 helicopter
Hillcrest Aircraft Co., Lewiston, Idaho - 4 helicopters
Johnson Flying Service, Inc., Missoula, Montana - 4 helicopters
Aero-Copters, Inc., Seattle, Washington - 3 helicopters
Central Air Service, Lewistown, Montana - 1 helicopter

Starting May 3 and continuing through July 23, 47,400 acres were sprayed. An additional 32,470 acres were treated during August 25 through October 6.

All water used in formulating aerial spray solutions during 1965 was buffered with sodium bisulfate to a hydrogen-ion range between pH 4 and pH 6. In addition, with the exception of some solutions formulated on the Clearwater National Forest, all water used was passed through water softeners and reduced to less than 1.0 grain hardness. Some of the water on the Clearwater does not require softening. The effect of water hardness and the hydrogen-ion level of final spray solutions is being studied both in the laboratory and in the field.

The amount of aerial treatment with antibiotics in relation to treatment using hand methods is shown in table 11. Tables 12 and 13 summarize accomplishment and cost data for the 1965 aerial spray program.

Determination of treatment effectiveness continues to be a most difficult job. Because of wide variation in aerial spray results and the uncertainty of overall effectiveness, no aerial spraying will be done during 1966. It is hoped that evaluations made during the next season will provide information necessary to make an adequate evaluation of this program.

Table 11.--Region 1 summary of antibiotic treatment through 1965 (National Parks not included)

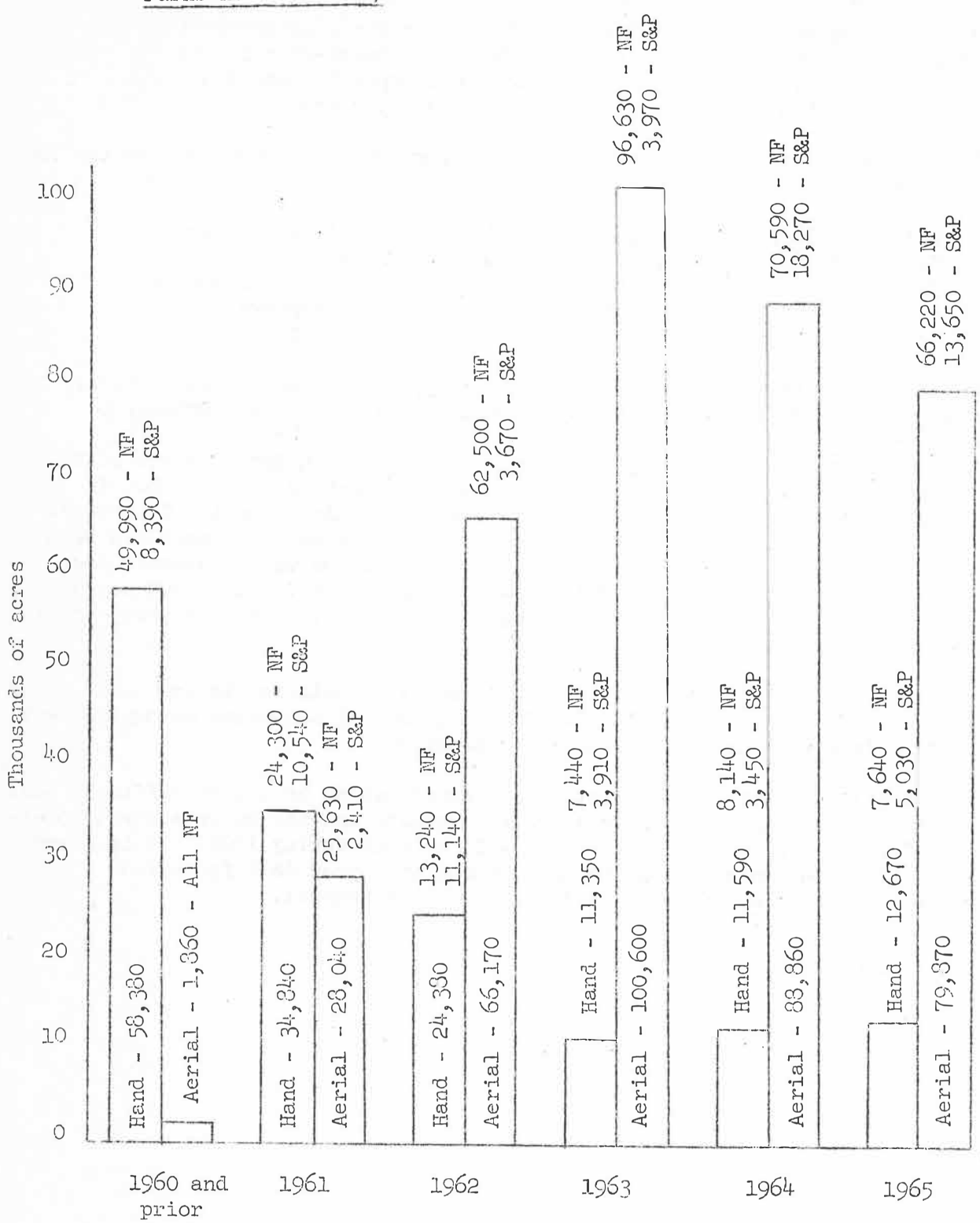


Table 12.--Production summary of 1965 aerial (helicopter) spraying

Item	Forest					Total average
	Clearwater	Coeur d'Alene	Kaniksu	Kootenai	St. Joe	
Acres sprayed	6,650	22,320	24,610	6,020	20,270	79,870
Number of spray loads	732	2,335	2,517	641	2,178	8,403
Gallons of solution sprayed	48,250	164,350	175,920	44,870	146,200	580,090
Gallons of solution per trip 1/	65.9	70.6	70.0	70.0	67.12	69.03
Gallons of solution per acre	7.26	7.39	7.15	7.45	7.21	7.26
Acres sprayed per hour - actual spray time 1/	70.4	65.26	62.72	71.8	64.21	65.02
Flight hours:						
Actual spraying	94.1	345.5	393.4	83.8	315.7	1,232.5
Base ferry	7.5	27.3	19.7	8.8	18.1	81.9
Orientation - spray area	4.9	16.7	17.6	5.2	22.8	67.2
Survey and other	0	18.9	25.8	0	4.1	48.3
Total BRC use - hours	106.5	408.9	456.5	97.8	360.7	1,430.4

1/ Per one helicopter.

Table 13.--Per acre cost summary of 1965 aerial (helicopter) spraying

Item	Forest					Total average
	Clearwater	Coeur d'Alene	Kaniksu	Kootenai	St. Joe	
Acres sprayed	6,650	22,320	24,610	6,020	20,270	79,870
Phytoactin	$7.11	$7.07	$6.87	$7.25	$6.85	$6.98
Helicopter	1.46	1.97	1.81	1.62	2.22	1.92
Salaries	.67	.55	.33	.44	.45	.46
Meal subsidy	.07	.06	.06	.17	.08	.07
Fuel oil	.23	.22	.23	.24	.22	.23
Other spray supplies	.03	.04	.04	.02	.04	.04
Equipment use	.17	.09	.10	.18	.11	.11
Other - camp construction, trailers, etc.	.24	.07	.15	.12	.07	.11
Total	$9.98	$10.07	$9.59	$10.04	$10.04	$9.92

VII. SCOUTING FOR WHITE PINE BLISTER RUST

A 2-week blister rust survey was conducted in western Wyoming and southern Idaho during September. Personnel from Forest Service Regions 1 and 4, the Intermountain Forest and Range Experiment Station, and the National Park Service participated in part or all of the examinations.

A total of 1,128 white pine and 1,555 ribes were examined in 20 drainages in five National Forests and two National Parks. Most of the examinations were made at or near previously reported pine or ribes infection centers near the known limits of the rust.

Blister rust was found for the first time on limber pine along the west branch of Pine Creek, approximately 10 miles southwest of Victor, Idaho, in the Targhee National Forest. Rust was reported on ribes at this location in 1955. An intensification of rust on limber pine was found in the same Forest along Darby Creek within 4 air miles of the Grand Teton National Park boundary. Rust was reported in this drainage on ribes in 1949 and on pine in 1955. One limber pine examined this year had 15 branch cankers located on 6- to 8-year-old tissue.

Rust was found for the first time on limber pine and ribes in the Snake River Canyon, along the southern boundary of Targhee National Forest. Numerous branch cankers, with up to 14 on one tree, were present on 6- to 8-year-old tissue on trees at eight scattered locations along a 15-mile section of the canyon. In most instances, trees with cankers were found quite easily between Highway 89 and the Snake River. The disease was also found to exist along several secondary drainages of the Snake River. The infection found along the Snake River Canyon constituted a 23-mile southern extension of the known limits of the rust on limber pine in western Wyoming. No infected whitebark pine has been reported in Wyoming outside of Yellowstone National Park.

The map (figure 5) shows the extent of white pine blister rust on both pine and ribes in the western States as of 1965. The California and Oregon information was furnished by Regions 5 and 6 respectively.

Table 14.--Scouting summary

Location	Number				
	Drainages sampled[1]	White pine		Ribes stems examined	Infected ribes stems[2]
		Examined	Infected		
Idaho:					
Cache NF	3	79	2	299	10
Targhee NF	2	80	0	47	16
Wyoming:					
Yellowstone NP	1	60	1	275	1
Grand Teton NP	1	235	0	88	1
Bridger NF	4	220	0	389	0
Shoshone NF	1	145	0	20	0
Targhee NF	4	176	18	297	5
Teton NF	4	133	1	130	0
Total	20	1,128	22	1,555	33

1/ Additional drainages visited are not reported because significant host associations were not found.

2/ All infections have been identified as Cronartium ribicola except for the one collected in Grand Teton National Park which has been identified as C. occidentale.

Whitebark pine stands on the slopes of Divide Mountain, Blackfeet Indian Reservation, were surveyed for blister rust by Glacier Park personnel. All trees 3 feet or more in height in 1/10-acre sample plots were examined. The youngest tree examined was estimated to be 25 years old. Whitebark pine comprised 57.7 percent of the 2,279 trees in the 11 sample plots. Some of the plots were in or near antibiotic test areas. Although the amount and intensity of infection is high, recent tree mortality from blister rust is low (table 15).

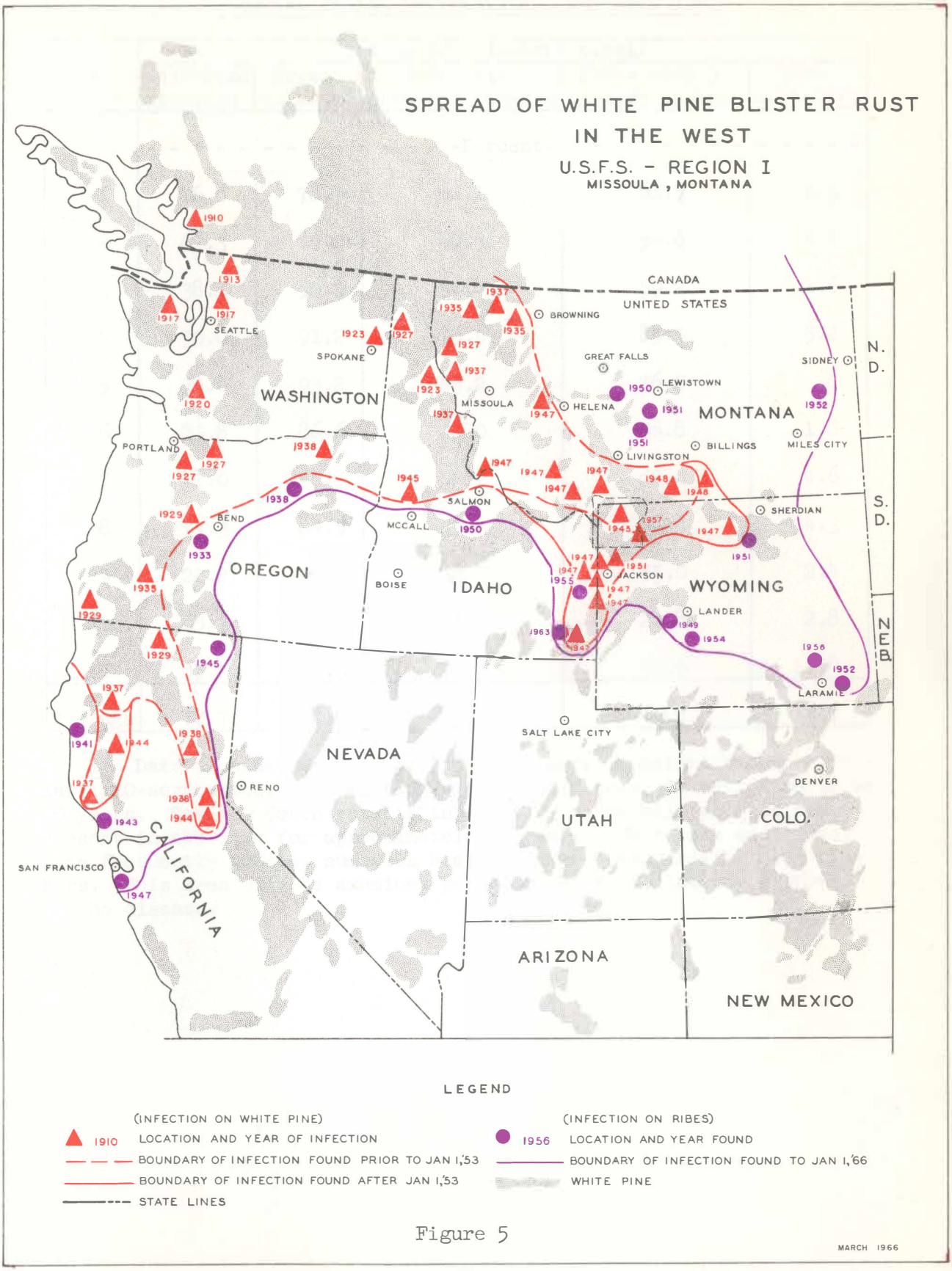


Figure 5

MARCH 1966

Table 15.--Whitebark pine blister rust survey, Hudson Bay Divide, Blackfeet Indian Reservation, September 1965

Plot number	Status of whitebark pine1/				
	Whitebark stocking	Trees infected	Trees with girdling cankers	Trees with 5 or more cankers	Tree mortality
	- - - - - - - - - - - - - - -Percent- - - - - - - - - - - - - - -
1	76.8	76.9	61.1	65.5	1.3
2	49.3	89.2	60.3	59.6	5.4
3	38.1	90.0	57.4	59.2	1.6
4	50.0	91.2	75.9	85.5	5.2
5	38.0	93.2	63.2	76.5	0
6	89.8	86.6	68.0	58.8	1.8
7	42.0	96.4	56.2	80.0	4.6
8	75.3	84.5	37.4	36.6	4.3
9	22.2	100.0	32.5	55.0	2.4
10	68.3	74.6	71.2	24.8	2.8
11	85.4	94.3	71.2	82.6	11.4
Average	57.7	88.8	59.5	62.2	3.7

1/ Data obtained from trees 3 feet or more in height within circular 1/10-acre plots. The minimum age of these trees is estimated to be 20 years. The low death rate is interesting since blister rust has been present in the area for approximately 30 years. Whitebark and limber pine frequently possess numerous branch cankers and girdling stem cankers. This area will be examined periodically to follow the progress of the disease.

VIII. STATISTICAL TABLES

Statistical tables summarizing accomplishments on a calendar year basis and expenditures on a fiscal year basis for each program and a total of all programs are presented in this section. Except where noted, the figures given for National Forests include Public Domain lands.

An explanation of the tables for the total of all programs follows. The tables for individual programs are similar.

1. Blister Rust Control Expenditures.

   All funds expended in Region 1, including research reimbursement items for developmental work during fiscal year 1965, July 1, 1964 through June 30, 1965.

2. Field Organization.

   Self-explanatory.

3. Total Progress of Ribes Eradication.

   All areas worked either initially or reworked are included. The area in table 4 and all work done with Sale Area Betterment (K-V) funds are included.

4. Chemical Eradication.

   This table shows the acres sprayed with 2,4,5-T herbicide to eradicate ribes. The application was from truck-mounted or backpack sprayers and helicopters. These data are included in table 3.

5. Antibiotic Treatment.

   The number of trees treated is determined from random plot counts. The gallons of solution reported are almost all Acti-dione BR solution for the hand treatments and all Phytoactin for the aerial treatments. A small amount of Phytoactin solution was used on some hand-treated areas.

6. Surveys.

   a. Type - Ribes. Includes all types of checking, disease surveys, and preeradication surveys done for the purpose of ribes eradication.

   b. Type - Antibiotic. Includes all types of survey work done for the purpose of determining areas to be treated with antibiotics. Flying time directly connected with actual spraying is not included. Systematic inspection of treated areas to determine effectiveness is included.

7. Ownership and Ribes Control Status.

The acres reported are on the basis of ribes eradication only. The antibiotic treatment program is not considered. Very little ribes eradication work has been done in western white pine stands over 10 years of age during the last few years. The figures reported may need some updating.

8. Net Acres of White Pine by Age Classes.

This table includes all areas satisfactorily stocked with white pine. The areas reported for the National Forest, and the State and Private programs have 20 percent or more white pine stocking. The area of white pine type based on plurality of stems or volume is much less than this. This table includes stands which are not white pine type by definition but where blister rust control work is necessary to maintain an adequately stocked stand. All areas that have been approved for white pine management and those areas where the present stand can be brought through to maturity with the application of antibiotics or with ribes eradication are included. White pine sites presently unsatisfactorily stocked and protection zones are not included. The data reported for the National Forest program include only National Forest and Public Domain land. The data reported for the State and Private program include only State and private lands.

9. Accumulative Summary of Antibiotic Treatment.

The acres reported as treated to date include some that have been retreated.

10. Antibiotic Treatment by Date and Ownership.

This table shows all antibiotic treatment work done to date in Idaho and Montana except Glacier National Park. The accumulative acres by dates will not necessarily add up to the totals shown in the summary section because of retreatment. Acres reported in the summary are the total treated to date regardless of retreatment. Some of these acres have been treated twice. An acre is reported in the summary only once--the first time it is treated. It is then carried along until the stand is cut or destroyed.

11. Ownership in Blister Rust Control Programs.

The area shown as National Forest program includes only National Forest and Public Domain lands. Only State and private land is included in the State and Private program. Intermingled lands have been separated and are reported in the respective programs on the basis of ownership.

SUMMARY OF ALL PROGRAMS

1. Blister Rust Control Expenditures, Fiscal Year 1965.

State	U.S. Forest Service, Region 1					State and Private	National Park Service	Total
	042	720	411	K-V	Total			
Idaho	1,482,613	20,326	126,198	87,329	1,716,466	87,400	--	1,303,866
Mont.	159,844	--	--	5,619	165,463	--	40,163	205,626
Wash.	199,069	--	--	13,781	212,850	--	--	212,850
Colo.	--	--	--	--	--	--	23,074	23,074
Wyo.	--	--	--	--	--	--	115,823	115,323
Total	1,841,526	20,326	126,193	106,729	2,094,779	87,400	179,060	2,361,239

126,198 126,148
1,968,581 3 598

2. Field Organization.

Program	Camps	Employees			Contractors
		Ribes eradication	Antibiotic treatment	Total	
National Forest	18	218	217	435	1
National Park	5	85	20	105	--
State & Private	3	--	65	65	--
Total	26	303	302	605	1

3. Total Progress of Ribes Eradication.

Ownership	Acres	Man-days	Ribes	Per acre	
				Man-days	Ribes
National Forest	6,570	6,477	1,967,150	0.99	299
National Park	11,830	4,120	968,000	.35	82
State & Private	10	5	50	.50	5
Total	18,410	10,602	2,935,200	.58	159

4. Chemical Eradication.

Ownership	Acres	Man-days	Ribes destroyed	Gallons of spray solution	Man-days per acre
National Forest	1,560	1,135	1,252,800	139,590	0.73
National Park	330	1,310	757,000	40,650	3.97
State & Private	--	--	--	--	--
Total	1,890	2,445	2,009,800	180,240	1.29

SUMMARY OF ALL PROGRAMS

5. Antibiotic Treatment.

Ownership	Method	Acres treated	Trees treated	Gallons solution	Man-days	Helicopter hours
National Forest	Hand	7,640	481,500	25,410	5,621	--
	Aerial	66,220	8,583,300	477,530	1,160	1/ 1,148.2
	Total	73,860	9,064,800	502,940	6,781	1,148.2
National Park	Hand	740	124,000	2,420	580	--
State & Private	Hand	5,030	329,630	10,010	2,027	--
	Aerial	13,650	1,317,470	99,100	278	233.4
	Total	18,680	1,647,100	109,110	2,305	233.4
Total	Hand	13,410	--	37,840	8,228	--
	Aerial	79,870	--	576,630	1,438	1,381.6
	Total	93,280	10,835,900	614,470	9,666	1,381.6

1/ An additional 19.6 hours used on ribes eradication and mountain pine beetle surveys.

6. Surveys.

Ownership	Type	Acres	Man-days	Helicopter hours
National Forest	Ribes	5,010	125	--
	Antibiotic	218,400	2,260	45.2
	Total	223,410	2,385	45.2
National Park 1/	Ribes	21,340	350	--
	Antibiotic	--	60	--
	Total	21,340	410	--
State & Private	Ribes	1,060	25	--
	Antibiotic	38,570	255	3.6
	Total	39,630	280	3.6
Total	Ribes	27,410	500	--
	Antibiotic	256,970	2,575	48.8
	Total	284,380	3,075	48.8

1/ Includes White Pine-Ribes Distribution and Disease Survey, Bryce Canyon National Park and Cedar Breaks National Monument, 11,330 acres and 90 man-days.

SUMMARY OF ALL PROGRAMS

7. Ownership and Ribes Control Status - Acres.[1/]

Ownership	Total[2/]	Worked initially	Work remaining		Maintenance
			Initial (unworked)	Rework	
National Forest	1,173,160	541,540	631,620	260,860	280,680
National Park	[3/]135,140	82,180	52,960	19,120	63,060
State & Private	519,280	208,210	311,070	105,990	102,220
Total	1,827,580	831,930	995,650	385,970	445,960

1/ As of June 30, 1965.
2/ Includes protection zones.
3/ Only those acres inside ribes eradication units.

8. Net Acres of White Pine by Age Classes.

Ownership	Age classes by date of origin						Total acres
	1980-1961	1960-1941	1940-1921	1920-1881	1880-1841	1840 & prior	
National Forest	12,300	28,570	208,210	408,740	54,560	323,420	1,036,300
National Park	- - - - - - - - -Not classified- - - - - - - - -						143,030
State & Private	2,400	44,740	93,470	129,610	20,720	153,830	444,770
Total	15,200	73,310	301,680	538,350	75,280	477,250	1,624,100

9. Accumulative Summary of Antibiotic Treatment.

Ownership	Idaho		Montana		Washington		Total	
	Total acres	Treated to date	Total acres	Treated to date	Total acres	Treated to date	Acres	Treated to date
National Forest	866,080	319,890	92,570	34,380	77,650	33,400	1,036,300	387,670
National Park 1/	--	--	13,900	11,070	--	--	13,900	11,070
State & Private	431,800	73,470	4,470	--	8,500	--	444,770	73,470
Total	1,297,880	393,360	110,940	45,450	86,150	33,400	1,494,970	472,210

1/ Only Glacier National Park has an antibiotic treatment program.

10. Antibiotic Treatment by Date and Ownership - Acres.

Owner	1961 and prior	1962	1963	1964	1965	Summary				Total
						Within association		Outside association		
						Hand	Aerial	Hand	Aerial	
National Forest	99,940	75,110	102,710	77,160	73,650	18,870	16,280	69,230	278,340	382,720
Public Domain	530	1,390	1,610	1,240	210	180	740	150	3,880	4,950
State lands	17,070	7,740	4,680	13,350	10,290	20,800	15,190	2,650	6,740	45,380
L. Cardiff, Inc.	160	110	--	--	--	160	110	--	--	270
Diam. Nat. Corp.	170	400	--	230	60	200	200	30	370	800
Joslyn Mfg. Co.	--	--	--	220	--	--	--	--	220	220
Mead & Howard	--	10	30	--	60	10	60	30	--	100
Milwaukee Land	560	170	210	560	580	20	230	840	770	1,860
N. Pacific	--	290	30	--	270	--	--	--	320	320
P.F.I.	3,520	5,300	2,850	5,600	6,970	9,510	10,060	830	1,170	21,570
Other private	970	100	70	1,760	450	670	200	220	1,860	2,950
Total	122,920	90,620	112,190	100,120	92,540	50,420	43,070	73,930	293,670	461,140

518,390

11. Ownership of Areas in Blister Rust Control Program.

Item	National Forest	Public Domain	National Park	State	Private	Total
White pine stocked	1,015,080	21,220	1/ 143,030	154,550	290,220	1/ 1,624,100
Protection zone areas	135,320	1,540	--	22,480	52,030	211,370
Total	1,150,400	22,760	143,030	177,030	342,250	1,835,470

1/ Includes 7,890 treatable acres outside ribes eradication units.

FEDERAL LANDS

1. Blister Rust Control Expenditures, Fiscal Year 1965.

Forest	042 Funds 1/	K-V Funds	Total
Clearwater	2/ 350,250	67,603	418,018
Coeur d'Alene	411,058	8,071	418,964
Colville	--	1,725	1,725
Kaniksu	441,607	20,787	462,394
Kootenai	31,344	5,619	36,963
St. Joe	348,578	2,924	351,502
Total	1,582,837	106,729	1,689,566

1/ Does not include development, improvement, and Regional Office expenditures.

2/ Expenditures reduced $165 to account for power sprayer repair done for the Coeur d'Alene NF.

2. Field Organization.

Forest	Camps	Employees			Contractors
		Ribes eradication	Antibiotic treatment	Total	
Clearwater	5	140	15	155	--
Coeur d'Alene	4	30	51	81	--
Colville	1	10	--	10	--
Kaniksu	4	23	57	80	1
Kootenai	2	7	8	15	--
St. Joe	2	8	86	94	--
All Forests	18	218	217	435	1

FEDERAL LANDS

3. Total Progress of Ribes Eradication.

Forest	Acres	Man-days	Ribes	Per acre	
				Man-days	Ribes
Clearwater	3,630	4,056	1,254,550	1.12	346
Coeur d'Alene	990	979	213,900	.99	216
Colville	130	149	10,300	1.15	79
Kaniksu	1,380	797	92,300	.58	67
Kootenai	260	203	70,700	.78	272
St. Joe	180	293	325,400	1.63	1,808
All Forests	6,570	6,477	1,967,150	.99	299

4. Chemical Eradication.

Forest	Acres	Man-days	Ribes destroyed	Gallons of spray solution	Man-days per acre
Clearwater 1/	1,390	893	1,060,800	108,090	0.64
Coeur d'Alene	80	104	60,000	10,700	1.30
Colville	--	--	--	--	--
Kaniksu	60	83	66,000	10,300	1.38
Kootenai	30	55	66,000	10,500	1.83
St. Joe 2/	--	--	--	--	--
All Forests	1,560	1,135	1,252,800	139,590	.73

1/ 9.1 helicopter hours used.
2/ 1.9 helicopter hours used.

FEDERAL LANDS

5. Antibiotic Treatment.

Forest	Method	Acres treated	Trees treated	Gallons solution	Man-days	Helicopter hours
Clearwater	Hand	550	97,200	4,410	563	--
	Aerial	1,840	187,500	13,330	42	1/ 29.2
	Total	2,390	284,700	17,740	605	29.2
Coeur d'Alene	Hand	840	183,500	3,990	1,185	--
	Aerial	21,550	3,436,600	159,930	486	375.9
	Total	22,390	3,620,100	163,920	1,671	375.9
Kaniksu	Hand	1,110	59,000	7,930	1,267	--
	Aerial	24,010	3,451,200	167,530	223	416.6
	Total	25,120	3,510,200	175,460	1,490	416.6
Kootenai	Hand	290	24,100	1,620	166	--
	Aerial	6,020	435,200	44,370	149	97.8
	Total	6,310	459,300	46,490	315	97.8
St. Joe	Hand	4,850	117,700	7,460	2,440	--
	Aerial	12,800	1,072,800	91,870	260	2/ 228.7
	Total	17,650	1,190,500	99,330	2,700	228.7
All Forests	Hand	7,640	481,500	25,410	5,621	--
	Aerial	66,220	8,583,300	477,530	1,160	1,148.2
	Total	73,860	9,064,800	502,940	6,781	1,148.2

1/ An additional 17.7 hours used on ribes eradication and mountain pine beetle survey.

2/ An additional 1.9 hours used on ribes eradication.

6. K-V Work.

Forest	Ribes eradication		Antibiotic treatment				Total	
			Hand		Helicopter			
	Acres	Man-days	Acres	Man-days	Acres	Hours	Acres	Man-days
Clearwater	400	801	58	18	--	--	458	819
Coeur d'Alene	380	333	--	--	--	--	380	333
Colville	130	149	--	--	--	--	130	1/ 149
Kaniksu	80	102	--	--	450	8.2	530	109
All Forests	990	1,385	58	18	450	8.2	1,498	1,410

1/ Includes 7 man-days of aerial antibiotic treatment.

FEDERAL LANDS

7. Surveys.

Forest	Type	Acres	Man-days	Helicopter hours
Clearwater	Ribes	3,220	85	--
	Antibiotic	45,390	461	1/ 0
	Total	48,610	546	0
Coeur d'Alene	Ribes	500	6	--
	Antibiotic	44,700	613	16.9
	Total	45,200	619	16.9
Colville	Ribes	90	2	--
	Antibiotic	2,290	14	--
	Total	2,380	16	--
Kaniksu	Ribes	420	18	--
	Antibiotic	59,450	525	24.2
	Total	59,870	543	24.2
Kootenai	Ribes	200	2	--
	Antibiotic	12,970	121	--
	Total	13,170	123	--
St. Joe	Ribes	580	12	--
	Antibiotic	53,600	526	4.1
	Total	54,180	538	4.1
All Forests	Ribes	5,010	125	--
	Antibiotic	218,400	2,260	45.2
	Total	223,410	2,385	45.2

1/ 3.6 hours used for mountain pine beetle survey.

FEDERAL LANDS

8. Ownership and Ribes Control Status - Acres.[1/]

Forest	Total	Worked initially	Work remaining		Maintenance
			Initial (unworked)	Rework	
Clearwater	275,520	96,030	179,490	62,920	33,110
Coeur d'Alene	332,500	126,550	205,950	70,820	55,730
Colville	24,560	9,330	15,230	1,120	8,210
Kaniksu	338,300	197,240	141,060	67,910	129,330
Kootenai	40,280	19,190	21,090	6,390	12,800
St. Joe	162,000	93,200	68,800	51,700	41,500
Total	1,173,160	541,540	631,620	260,860	280,680

[1/] As of June 30, 1965.

9. Net Acres of White Pine by Age Classes.

Forest	Age classes by date of origin						Total acres
	1980-1961	1960-1941	1940-1921	1920-1881	1880-1841	1840 & prior	
Clearwater	9,460	16,330	29,110	51,200	12,430	156,990	275,520
Coeur d'Alene	1,210	7,790	57,020	114,620	6,690	114,430	301,760
Colville	90	--	4,140	12,050	8,910	450	25,640
Kaniksu	1,420	2,620	64,040	142,210	11,630	31,150	253,070
Kootenai	260	970	2,600	34,760	--	--	38,590
St. Joe	360	860	51,300	53,900	14,900	20,400	141,720
All Forests[1/]	12,800	28,570	208,210	408,740	54,560	323,420	1,036,300

[1/] Includes 21,220 acres of Public Domain.

FEDERAL LANDS

10. Accumulative Summary of Antibiotic Treatment.

Forest	Idaho		Montana		Washington		Total	
	Total acres	Treated to date	Total acres	Treated to date	Total acres	Treated to date	Acres	Treated to date
Clearwater	275,520	58,860	--	--	--	--	275,520	58,860
Coeur d'Alene	277,060	95,570	24,700	3,220	--	--	301,760	98,790
Colville	--	--	--	--	25,640	10,870	25,640	10,870
Kaniksu	169,140	66,500	31,920	9,510	52,010	22,530	253,070	98,540
Kootenai	2,640	590	35,950	21,650	--	--	38,590	22,240
St. Joe	141,720	98,370	--	--	--	--	141,720	98,370
All Forests	866,080	319,890	92,570	34,380	77,650	33,400	1,036,300	1/ 387,670

1/ Includes 4,950 acres of Public Domain.

STATE AND PRIVATE LANDS

1. Blister Rust Control Expenditures, Fiscal Year 1965.

Forest	Federal funds[1]			State and private funds[2]			Total all funds
	7203[3]	4114	Total	State	Private	Total	
Clearwater	5,504	45,430	50,934	22,682	10,675	3,357	54,291
Coeur d'Alene	1,921	4,388	6,309	--	--	--	6,309
Kaniksu	1,741	23,495	25,236	5,796	6,298	12,094	37,330
St. Joe	10,337	47,769	58,106	29,200	8,749	37,949	96,055
Total	19,503	121,082	140,585	57,678	25,722	83,400	193,985

1/ Does not include development, improvement, and Regional Office expenditures.

2/ An additional $4,000 is added to these amounts for contributed services.

3/ Includes leadership and technical service on Federal lands.

4/ Some of these expenditures are a carryover from an accelerated 1964 State and Private program which is not on a fiscal year basis.

2. Field Organization.

Forest	Camps	Employees			Contractors
		Ribes eradication	Antibiotic treatment	Total	
Clearwater	2	--	40	40	--
Coeur d'Alene	--	--	--	--	--
Colville	--	--	--	--	--
Kaniksu	--	--	--	--	--
Kootenai	--	--	--	--	--
St. Joe	1	--	25	25	--
All Forests	3	--	65	65	--

STATE AND PRIVATE LANDS

3. Total Progress of Ribes Eradication.

Forest	Acres	Man-days	Ribes	Per acre	
				Man-days	Ribes
Clearwater	10	5	50	0.5	5
Coeur d'Alene	--	--	--	--	--
Colville	--	--	--	--	--
Kaniksu	--	--	--	--	--
Kootenai	--	--	--	--	--
St. Joe	--	--	--	--	--
All Forests	10	5	50	0.5	5

4. Antibiotic Treatment.

Area	Forest	Method	Acres treated	Trees treated	Gallons solution	Man-days	Helicopter hours
Within association	Clearwater	Hand	1,850	294,030	5,680	1,077	--
		Aerial	4,810	197,770	34,650	108	77.3
		Total	6,660	491,800	40,330	1,185	77.3
	Coeur d'Alene	Hand	--	--	--	--	--
		Aerial	770	115,500	5,780	20	14.1
		Total	770	115,500	5,780	20	14.1
	Kaniksu	Hand	--	--	--	--	--
		Aerial	600	102,000	4,300	6	14.1
		Total	600	102,000	4,300	6	14.1
	St. Joe	Hand	2,640	26,300	3,840	773	--
		Aerial	5,460	770,900	40,810	98	92.7
		Total	8,100	797,700	44,650	871	92.7
	Total	Hand	4,490	320,830	9,520	1,850	--
		Aerial	11,640	1,186,170	85,540	232	198.2
		Total	16,130	1,507,000	95,060	2,082	198.2
Outside association	St. Joe	Hand	540	8,800	490	177	--
		Aerial	2,010	131,300	13,560	46	35.2
		Total	2,550	140,100	14,050	223	35.2
All Forests		Hand	5,030	329,630	10,010	2,027	--
		Aerial	13,650	1,317,470	99,100	278	233.4
		Total	18,680	1,647,100	109,110	2,305	233.4

STATE AND PRIVATE LANDS

5. Surveys.

Forest	Type	Acres	Man-days	Helicopter hours
Clearwater	Ribes	180	7	--
	Antibiotic	26,390	172	--
	Total	26,570	179	--
Coeur d'Alene	Ribes	--	--	--
	Antibiotic	2,000	2	2.0
	Total	2,000	2	2.0
Kaniksu	Ribes	--	--	--
	Antibiotic	4,740	42	1.6
	Total	4,740	42	1.6
St. Joe	Ribes	880	18	--
	Antibiotic	5,440	39	--
	Total	6,320	57	--
All Forests	Ribes	1,060	25	--
	Antibiotic	38,570	255	3.6
	Total	39,630	280	3.6

6. Ownership and Ribes Control Status - Acres.[1/]

Forest	Total	Worked initially	Work remaining		Maintenance
			Initial (unworked)	Rework	
Clearwater	165,630	53,740	111,890	31,090	22,650
Coeur d'Alene	66,180	5,660	60,520	2,770	2,890
Colville	3,260	1,350	1,910	800	550
Kaniksu	78,310	59,060	19,250	21,730	37,330
Kootenai	--	--	--	--	--
St. Joe	205,900	88,400	117,500	49,600	38,800
Total	519,280	208,210	311,070	105,990	102,220

1/ As of June 30, 1965.

STATE AND PRIVATE LANDS

7. Net Acres of White Pine by Age Classes.

Forest	Age classes by date of origin						Total acres
	1980-1961	1960-1941	1940-1921	1920-1881	1880-1841	1840 & prior	
Clearwater	--	38,380	46,290	18,560	11,350	49,470	164,050
Coeur d'Alene	--	460	8,150	31,140	2,020	21,670	63,440
Colville	--	--	310	1,810	310	120	2,550
Kaniksu	--	100	14,520	37,000	1,840	1,070	54,530
St. Joe	2,400	5,800	24,200	41,100	5,200	81,500	160,200
All Forests	2,400	44,740	93,470	129,610	20,720	153,830	444,770

8. Accumulative Summary of Antibiotic Treatment.

Forest	Ownership	Idaho		Montana		Washington		Total	
		Total acres	Treated to date	Total acres	Treated to date	Total acres	Treated to date	Acres	Treated to date
Clearwater	State	49,890	8,210	--	--	--	--	49,890	8,210
	Private	114,160	16,840	--	--	--	--	114,160	16,840
	Total	164,050	25,050	--	--	--	--	164,050	25,050
Coeur d'Alene	State	14,630	1,220	--	--	--	--	14,630	1,220
	Private	46,840	--	1,970	--	--	--	48,810	--
	Total	61,470	1,220	1,970	--	--	--	63,440	1,220
Colville	State	--	--	--	--	2,550	--	2,550	--
	Private	--	--	--	--	--	--	--	--
	Total	--	--	--	--	2,550	--	2,550	--
Kaniksu	State	35,240	13,010	680	--	710	--	36,630	13,010
	Private	10,840	1,060	1,820	--	5,240	--	17,900	1,060
	Total	46,080	14,070	2,500	--	5,950	--	54,530	14,070
St. Joe	State	53,400	22,940	--	--	--	--	53,400	22,940
	Private	106,800	10,190	--	--	--	--	106,800	10,190
	Total	160,200	33,130	--	--	--	--	160,200	33,130
All Forests	State	153,160	45,380	680	--	3,260	--	157,100	45,380
	Private	278,640	28,090	3,790	--	5,240	--	287,670	28,090
	Total	431,800	73,470	4,470	--	8,500	--	444,770	73,470

NATIONAL PARKS PROGRAM

1. Expenditures - Fiscal Year 1965.

National Park	State	Funds		
		National Park	National Forest	Total
Glacier	Montana	40,163	928	41,091
Grand Teton	Wyoming	183	--	183
Rocky Mountain	Colorado	23,074	--	23,074
Yellowstone	Wyoming	115,640	309	115,949
All Parks		179,060	1,237	180,297

2. Field Organization.

National Park	Camps	Employees		Total employees
		Ribes eradication	Antibiotic treatment	
Glacier	1	--	20	20
Rocky Mountain	1	15	--	15
Yellowstone	3	70	--	70
All Parks	5	85	20	105

3. Total Progress Ribes Eradication.

National Park	Acres	Man-days	Ribes	Per acre	
				Man-days	Ribes
Rocky Mountain	420	770	516,000	1.83	1,229
Yellowstone	11,410	3,350	452,000	.29	40
All Parks	11,830	4,120	968,000	.35	82

4. Chemical Eradication.

National Park	Acres	Man-days	Ribes	Gallons of solution
Rocky Mountain	50	440	473,000	17,250
Yellowstone	280	870	284,000	23,400
All Parks	330	1,310	757,000	40,650

5. Antibiotic Treatment.

National Park	Method	Acres treated	Trees treated	Gallons solution	Man-days	Man-days per acre
Glacier	Hand	1/ 740	124,000	2,420	580	0.78

1/ This includes 460 acres of retreatment.

6. Surveys.

National Park	Type	Acres	Man-days
Glacier	Antibiotic plots	--	60
Rocky Mountain	Premaintenance	350	30
Yellowstone	Premaintenance	1/ 20,990	1/ 320
All Parks		21,340	410

1/ Includes White Pine-Ribes Distribution and Disease Survey, Bryce Canyon National Park and Cedar Breaks National Monument, 11,880 acres and 90 man-days.

7. Ribes Eradication Control Status - Acres. 1/

National Park	Total	Worked initially	Work remaining		Maintenance
			Initial (unworked)	Rework	
Glacier	6,010	6,010	--	1,820	4,190
Grand Teton	1,010	1,010	--	100	910
Rocky Mountain	12,650	10,030	2,620	1,430	8,600
Yellowstone	115,470	65,130	50,340	15,770	49,360
All Parks	135,140	82,180	52,960	19,120	63,060

1/ As of June 30, 1965.

8. Accumulative Summary of Antibiotic Treatment - Acres.

National Park	Within units		Outside units		All units	
	Total	Treated to date	Total	Treated to date	Total	Treated to date
Glacier 1/	6,010	3,580	7,890	7,490	13,900	11,070
Grand Teton	1,010	--	--	--	1,010	--
Rocky Mountain	12,650	--	--	--	12,650	--
Yellowstone	115,470	--	--	--	115,470	--
All Parks	135,140	3,580	7,890	7,490	143,030	11,070

1/ At the present time, Glacier National Park has an antibiotic treatment program. Control in other Parks is based on a ribes eradication program only.

WHITE PINE BLISTER RUST CONTROL

Annual Report
Calendar Year 1966

U.S. DEPARTMENT OF AGRICULTURE
FOREST SERVICE
REGION ONE

MISSOULA, MONTANA

1380(5270)

UNITED STATES DEPARTMENT OF AGRICULTURE
FOREST SERVICE
REGION 1

Missoula, Montana
April 1967

WHITE PINE BLISTER RUST CONTROL ANNUAL REPORT
Calendar Year 1966

This report was prepared under the direction of E. H Juntunen, Chief, Division of State and Private Forestry, by David A. Graham, Head, Blister Rust Control Section, from information furnished by and from the following:

Clearwater National Forest	John P. Bushfield, Staff Officer Donald J. Temple, Forester Gerald C. Franc, Forester
Coeur d'Alene National Forest	Andy O. Fossum, Forestry Aid (TM) Neil Hyde, Forester
Kaniksu National Forest	Larry O. Smith, Forester
Kootenai National Forest	Frank J. Kapel, Forester Harold D. Ingrum, Forestry Aid (TM)
St. Joe National Forest	Clyde J. Miller, Staff Officer Oliver K. Goldammer, Forest Technician
Methods Development and Improvement Branch, Spokane	Virgil D. Moss, Chief, Wayne E. Bousfield, Forester Donald H. Brown, Forester
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Yellowstone National Park	John N. Reeves, Forestry Technician
Forestry Sciences Laboratory, INT, Moscow, Idaho	Richard T. Bingham, Project Leader, Rust Resistant White Pine Development Charles D. Leaphart, Project Leader, Chemical and Biological Forest Disease Control

The following agencies are conducting or are actively cooperating in white pine blister rust control:

U.S. Forest Service

National Park Service

I. HIGHLIGHTS OF 1966 BLISTER RUST CONTROL PROGRAM

A total of 19,270 acres, which included white pine stands and the protection zones, were treated by the Forest Service during the 1966 field season. This included 12,460 acres of National Forest ownership and 6,810 acres of State and private lands.

The National Forest control programs included basal stem antibiotic treatment of 1,990 acres of immature western white pine. Ribes eradication programs included 9,970 acres of hand eradication and 500 acres of chemical eradication using 2,4,5-T.

State and private cooperative programs included 3,700 acres of ribes eradication and 3,110 acres of basal stem antibiotic treatment.

National Park Service crews treated 14,900 acres during fiscal year 1966, including 1,200 acres of basal stem antibiotic treatment in Glacier Park.

A survey was conducted to determine the incidence of blister rust infection in stands from 3 to 21 years of age. All stands examined had a history of ribes eradication, with populations ranging from less than 1 to over 400 ribes per acre. An average annual infection rate of 3 percent was found in the stands regardless of ribes populations present. As a result, no ribes eradication will be done in the western white pine type during 1967.

Evaluation of the antibiotic treatment program was continued. The direct treatment including scarification of the infected area using Acti-dione BR appears to be the only method that gives us some control. The use of this method is now limited to western white pine stands on the best sites. Stands to be treated must have less than 150 crop trees of all species per acre, and the average white pine crop tree requiring treatment must be 6 inches d.b.h. or greater. All lethal infections must be within reach of the ground and less than one-half around the tree bole.

General

A total of 19,270 acres of white pine and protection zone in Region 1 were treated for blister rust control. There were 549 employees engaged in blister rust control work during the season; 410 on National Forest and 139 on State and private programs. In addition, three contractors removed ribes from selected white pine stands on National Forest lands.

The State and Private cooperative program in north Idaho was continued during 1966. Contributions from both the private landowners and the State of Idaho were the same as they have been during the last several years. Neither Montana nor Washington had a cooperative blister rust control program.

The total white pine areas in the National Forest, and State and private programs treated with antibiotics to date include 126,850 acres treated by basal stem methods and 336,740 acres treated from the air by helicopters. Approximately 59,900 acres within these areas have been retreated due to unsatisfactory initial treatment results.

Due to inconclusive effectiveness data, aerial spraying with Phytoactin has been discontinued. No antibiotic aerial spraying has been done in this Region since October 1965.

All basal stem treatment work included scarification of the infection on the tree bole. Only stands where the majority of damaging infection was within reach from the ground were treated by this method. Only infected potential crop trees that were less than one-half girdled were treated in the stands selected. Infections are thoroughly scarified and sprayed with an Acti-dione BR-fuel oil solution.

U.S. FOREST SERVICE AND TIMBER PROTECTIVE ASSOCIATIONS

CALENDAR YEAR 1966 (JANUARY 1-DECEMBER 31)

Clearwater National Forest and Clearwater-Potlatch Timber Protective Association

Basal stem antibiotic work was done on State and private lands in the Browns Creek and Casey Creek units.

Ribes were hand eradicated from areas in the Orofino Creek, Sheep Mountain, Pine Creek, Alder Creek, China-Moose Creek, and Musselshell Creek units.

Chemical eradication of ribes included the retreatment of two clear-cut blocks in the China-Moose Creek unit. This was a helicopter application of 2,4,5-T herbicide to a 430-acre block initially treated in August 1965. The two treatments killed both ribes and brush, removed competition, and resulted in easier planting of white pine and hand eradication of the remaining ribes.

A 16-man mobile trailer camp was used for the Alder-Pine Creek ribes eradication crew.

Three ribes eradication contracts were awarded in 1966. Two of the contracts (116 acres) in the Musselshell unit were completed. The contractor employed women workers on this contract. The third contract, awarded in October 1966, included three areas (201 acres) in Nelson Creek and one area in East Fork Canal Gulch. No eradication work has been previously done on this area.

Coeur d'Alene National Forest

Basal stem antibiotic work was done in the Hudlow and Snowbird units. The stands were first examined for amount of rust damage and stocking. Only those stands where the treatable diseased trees were needed for minimum stocking were treated.

Ribes were removed by hand methods from areas in the potter creek, Flat Creek, Yellow Dog, Deception Creek, and Burnt Cabin units.

Kaniksu and Colville National Forests
and Priest Lake Timber Protective Association

Basal stem antibiotic treatment of young white pine was completed on 660 acres by crews stationed at Kalispell Creek and the Falls Creek Ranger Station.

Ribes eradication crews were stationed at Hughes Meadows and Priest Lake.

One 50-acre ribes eradication contract was completed during 1966. Another contract was awarded but not completed.

Control work was not performed on Priest Lake Timber Protective Association lands.

Kootenai National Forest

Basal stem antibiotic treatment was completed on young white pine in the South Fork of Callahan Creek compartment.

Ribes eradication was confined to areas of established white pine stands less than 10 years old in the Pete Creek compartment.

Crews were quartered at the Troy and Sylvanite Ranger Stations. No temporary camps were necessary.

The project had another effective safety program without any reportable accidents. With continued stress on safety, the operation completed its 14th consecutive year without a lost-time accident.

St. Joe National Forest and Clearwater-
Potlatch Timber Protective Association

Three 30-man field camps were employed on blister rust control work during 1966. The camps were located at the Clarkia Ranger Station, Bob's Creek, and Elk River Work Center.

The Clarkia camp basal stem treated white pine with antibiotics in the Hatton Creek, Bussel Creek, and Clarkia control units.

Ribes were eradicated by hand from areas in the Fisher-Cranberry, Bob's Creek (State and private), and Clarkia units.

A helicopter was used to apply the herbicide 2,4,5-T to heavy ribes concentrations in prescribed burned blocks in Fisher-Cranberry and Bechtel Mountain areas.

NATIONAL PARK SERVICE, MID-WEST REGION
Fiscal Year 1966
(July 1, 1965-June 30, 1966)

The fiscal year 1966 program was conducted as provided by the Lea Act and the current agreement between the U.S. Department of Interior and the U.S. Department of Agriculture. The National Park Service has complete responsibility for planning, operational activities, and coordination between the Parks involved in blister rust control activities. The U.S. Forest Service furnishes interagency leadership and technical assistance in accordance with the agreement between the two agencies.

Glacier National Park

Initial basal stem antibiotic work was completed in the Coal Creek unit. Portions of the North Fork, Lake McDonald, McDonald Creek, and Mineral Creek units were retreated. All work done was on the west side of the Continental Divide in stands of western white pine. Periods of inclement weather prevented the accomplishment of all work planned. Ribes eradication work was not done.

Accomplishments included initially treating 47,500 immature western white pines on 280 acres, and retreating 101,100 immature trees on 920 acres in the above areas. The antibiotic formulation Phytoactin L-440 at 200 p.p.m. in fuel oil with surfactant was used during the first half of the year, and Acti-dione BR at 150 p.p.m. in fuel oil with Triton B-1956 during the second half. Only the basal stem direct canker treatment method with scarification was used.

Cooperation with the U.S. Forest Service in establishing and evaluating whitebark and limber pine studies was continued. Study plots include basal stem and aerial (helicopter) applications. An effective control for blister rust on these high-altitude white pines is urgently needed.

Yellowstone National Park

Recent disease surveys indicate the rust is intensifying in the northern portions of the Park and spreading southward. To meet this development, higher priorities were given to the stands in close proximity to areas of intensification. Ribes eradication work was concentrated in the Obsidian Cliff, Lake Shore, and Willow Park areas.

All program objectives scheduled for fiscal year 1966 were achieved or surpassed. Initial ribes eradication was accomplished on 11,060 acres utilizing 3,360 man-days of labor.

An additional 2,220 acres were maintained with touchup rework as scheduled. Included in the areas worked initially are 310 acres treated by chemical eradication methods. A considerable amount of ribes status checking was done to determine the degree of stabilization and future work requirements.

Grand Teton National Park

No ribes eradication was done. The Snake River-Deadman's Bar area was examined for rust during the fall inspection trip and one Ribes viscosissimum specimen was collected with rust later identified as Cronartium occidentale (pinon rust). White pine blister rust has been previously found on limber pine in this area.

Rocky Mountain National Park

Initial ribes eradication was completed on 420 acres. Included were 50 acres of heavy ribes at timberline and in the ski runs of upper Hidden Valley that were sprayed with portable power units. Another 15 acres in the Beaver Ponds area, which lie adjacent to the Trail Ridge Road, were hand eradicated because of the dense willow growth and high susceptibility of willow to hormone sprays. Much of this work was accomplished in knee-deep water.

Beginning with the 1966 spring program, the species R. montigenum is no longer being eradicated on the Hidden Valley-Windy Gulch unit. This decision was based on the low susceptibility of the species to rust and the mass density of the species in the work unit. Appreciable savings in labor and costs will result.

II. RIBES ERADICATION EFFECTIVENESS SURVEY

A blister rust incidence survey was completed in 1966 on 53 stands of young white pine between 3 and 20 years of age. The purpose was to determine the correlation between the amount of blister rust infection in these stands and past ribes eradication efforts. An average of 3 percent infection per year is occurring in these stands, irrespective of present or past ribes populations. A more complete report is currently being prepared.

Additional blister rust incidence surveys will be made during 1967 to determine the rate and intensity of infection occurring in white pine stands 20 to 50 years of age.

Ribes population and stand description surveys (compartment examination - Stage II) are made a part of each blister rust incidence examination.

III. ANTIBIOTIC TREATMENT EFFECTIVENESS EVALUATIONS

The collection of canker evaluation data from established study strips in antibiotic treated and untreated areas was continued on all Forests in 1966. As reported previously, the determination of the effectiveness of this phase of the control program is most difficult. The wide variation in apparent results is complicated by the natural variation from year to year in canker activity. The results reported in table 1 are tentative only and are shown primarily to point out some of the variation associated with basal stem with scarification treatments. Aerial treatment results are much more variable. They are not reported here because this method of treatment has not been used since 1965.

Table 1.--Antibiotic treatment evaluation summary, Division of State and Private Forestry, 1966

Forest	Area	Cankers 1/ inactive	Percent	Cankers 2/ controlled	Percent	Cankers live 3/	Percent	Total cankers
- - - - - - - Acti-dione with scarification - treated 1964 - - - - - - - -								
St. Joe	73	16	27.1	23	39.0	20	33.9	59
	75	33	75.0	5	11.4	6	13.6	44
	82	29	80.6	0	0	7	19.4	36
Kaniksu	36	27	49.1	8	14.5	20	36.4	55
	35	18	26.1	16	23.2	35	50.7	69
	34	41	56.1	11	15.1	21	28.8	73
- - - - - - Phytoactin L-440 with scarification - treated 1964 - - - - - -								
Coeur d' Alene	83	24	42.9	12	21.4	20	35.7	56

All areas were treated on an operational basis. None of these data are from developmental plots. All examinations were made during 1966.

1/ Cankers are classified as "inactive" if:

1. All bark within canker area is brownish-black in color, shriveled, and sunken.
2. Callus tissue is visible on more than 50 percent of the total canker perimeter.
3. No sporulation is present.
4. No discoloration is present.
5. No Tuberculina maxima (sporulation) is present.
6. Recent (within past year) rodent chewing is not evident.
7. Study canker or another canker has not girdled the tree.

Table 1.--Antibiotic treatment evaluation summary, Division of State and Private Forestry, 1966 (con.)

2/ Cankers are classified as "controlled" if:

1. Margin of discoloration is less than one-fourth of total canker perimeter.
2. No sporulation present.
3. No recent (within past year) rodent chewing.
4. Study canker or another canker has not girdled the tree.
5. Tuberculina maxima is present.

3/ Any canker that has girdled the tree is called "live." Study cankers on trees that have been girdled by other cankers that may affect the vigor of the study canker are also called "live."

IV. SPREAD OF BLISTER RUST

Personnel from the Forest Service in Regions 1 and 2 and the National Park Service participated in a 2-week blister rust disease survey in north-central Wyoming throughout the Wind River Indian Reservation, and Big Horn and Shoshone National Forests. The purpose of the survey was to determine the advancement of the rust on both pine and ribes from presently known infection centers. The blister rust was found to be intensifying in limber pine in several areas on the east side of the Big Horn Mountain Range. In contrast, the west side of the range revealed light infection. Detailed results will be published as a separate report.

V. ANTIBIOTIC RESEARCH 1/

In 1966 final examinations were made on the two experiments described in the Annual Report for 1965 (pages 42-44) to test the effectiveness of Acti-dione and Phytoactin.

The data, summarized in table 2 by treatments, suggest the following conclusions:

Aerial treatments. --Aerial treatment with Phytoactin is not an effecitve control for blister rust, as has already been concluded by regional personnel in terminating this aspect of their control effort. No significant differences were found between the Phytoactin, the oil check, or the untreated aerial treatments; i.e., the percent of inactive cankers averaged near 1 percent, and canker activity averaged nearly alike for all three treatments after three full growing seasons.

Basal stem treatments.--After four growing seasons, no significant differences were found between the first five treatments (table 2); the percent of inactive cankers ranged from 0 to 1. The Acti-dione treatment was significantly different from the other five, but only 26 percent of the treated cankers were inactive (22 percent were inactive in both 1965 and 1966). In addition, all trees having an inactive canker in this treatment also had at least one active canker either within the treatment zone or above it.

These studies confirm tests on other white pine species; i.e., these two antibiotics are not effective control agents for the blister rust disease. As observed by Phelps in his work with eastern white pine, Acti-dione treatments appear to be chemical excision treatments. If done properly and carefully with scarification, it may be possible to isolate infected tissue from uninfected tissue and, thereby, to induce complete inactivity and perhaps death of cankers. With incomplete scarification a significant, but only partial, reduction in activity may result. As indicated by the canker activity indices for the controls in both aerial and basal stem treatments (table 2), a significant reduction of activity occurs over time in a selected population of cankers because of natural factors. These seriously confound interpretations of treatment effects under forest conditions.

Procedures have been developed for the establishment of cambial explants of Pinus monticola in axenic culture. Vigorous callus tissue has been maintained through monthly subculture for a period of 16 months with no significant reduction in volume growth. Preliminary tests indicate that cambial explants infected with Cronartium ribicola are amenable to axenic culture and produce infected callus. Successful growth of rust fungus in callus culture will provide the necessary means for conducting physiological studies of the fungus and screening potential chemotherapeutants.

Study of Tuberculina maxima, a potential biologic control agent of blister rust, has shown it to be widely distributed and frequently found within the range of P. monticola. It is capable of overwintering in both the vegetative and

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1/ Based on work conducted by the Intermountain Forest and Range Experiment Station, Moscow, Idaho.

spore stages. Although these are desirable attributes of a biologic control agent, T. maxima has some known disadvantages, including low infectivity, low virulence, and variable impact on canker vigor. Mode of action studies will explore how these drawbacks might be modified to increase the effectiveness of this fungus as a control agent.

Table 2.--Evaluation of antibiotics for control of blister rust on western white pine

Treatment	Trees1/		Cankers1/				Average of the percent of margin that was active on the basis of discoloration in 1966			
				Percent			Percent			
	Total No.	Percent killed by blister rust	Total No.	On trees killed--blister rust	Inactive	Active	1963	1964	1965	1966
				BASAL STEM TREATMENTS						
Untreated	85	6	87	7	1 (NS)	92	98.4	89.8	68.4	2/48.2
Scarification only	85	7	88	7	0 (NS)	93	96.9	80.6	64.1	2/38.6
Scarifica- + oil	85	5	89	6	1 (NS)	93	97.1	45.6	41.3	60.5
Scar. + oil + surfactant	85	4	85	4	0 (NS)	96	97.8	61.4	59.0	2/58.5
Scar. + oil + surf. + Phytoactin	85	2	86	2	0 (NS)	98	99.1	28.3	32.3	58.7
Scar. + oil + surf. + Acti-dione	85	13	88	14	26 (S)	60	99.2	4.4	3.9	8.1
				AERIAL TREATMENTS						
Untreated	175	7	193	7	2 (NS)	91	--	87.4	58.2	35.3
Oil emulsion + surfactant	175	11	193	13	1 (NS)	86	--	82.2	52.0	42.0
Oil emulsion + surf. + Phytoactin	176	13	205	12	1 (NS)	87	--	87.1	66.7	32.3

1/ Status as of 1966 examinations.

2/ The percent of active canker margin has decreased each year since plot establishment.

NS - Not significant

S - Significant

VI. WHITE PINE ECONOMIC STUDY

The rough draft of the western white pine production and management economic study has been completed by the Intermountain Forest and Range Experiment Station and Region 1 personnel. This study includes basic resource data and the cost of growing and protecting white pine.

The final report will be published in 1967.

VII. BREEDING BLISTER RUST-RESISTANT WESTERN WHITE PINE - 1966

Because of the recent regional decision to curtail blister rust control by means of ribes eradication or antibiotic treatment of white pines, development of resistant planting stock now remains as the best long-range means for controlling the disease. The cooperative Region 1-Intermountain Forest and Range Experiment Station program for development of such planting stock is now well along toward its initial objective.

First-stage seed orchards that will mass-produce second-generation (F_2) white pine planting stocks will be established at Coeur d'Alene, Idaho, and Haugan, Montana, beginning in 1971. First-generation (F_1) foundation stocks destined for establishing these orchards are already in production at the Forestry Sciences Laboratory nursery in Moscow, Idaho. The remainder will be produced and planted at the orchard sites between 1967 and 1974. Thus, we will attain our initial goal--earliest possible production of semiresistant planting stock--by about 1985, when these first-stage orchards come into production.

Naturally, these partially resistant but otherwise unimproved F_2 planting stocks, wherein it is estimated that only about half of the plants will survive long-term field exposure to the rust, are considered only an interim product of the overall research and development program. Orchard and planting costs will be lowered by increasing resistance of the stock, and increased timber yields will be achieved through selection for growth rate among resistant types.

Work toward attaining this longer-range goal will begin in 1967 by searching for about 2,800 more rust-free "candidate" trees in heavily infected natural stands. These new candidates, along with 400 already on hand, will provide the broader genetic base required for making additional gains in resistance, plus improvement of growth rate. Second-stage orchards from this base will succeed first-stage orchards after 15 to 20 years.

New methods [2/] developed at Moscow will reduce the costs of this new work materially. Savings in pollinating and testing new candidates using single, mixed-pollen crosses (instead of conventional series of four or more test crosses) will amount to about $400 per tree tested. With 2,800 new candidates to be tested, these methods improvements will save over $1 million.

2/ Cf. Int. For. & Range Expt. Sta. Res. Note INT-60: 4 pp. 1967.

VIII. STATISTICAL TABLES

Statistical tables summarizing accomplishments on a calendar year basis and expenditures on a fiscal year basis for the National Forest and State and Private programs and a total of all programs are presented in this section. Except where noted, the figures given for National Forests include Public Domain lands. Both accomplishments and expenditures are shown on a fiscal year basis for the National Park program.

SUMMARY OF ALL PROGRAMS

1. Blister Rust Control Expenditures, Fiscal Year 1966[1/]

State	U.S. Forest Service, Region 1 (funds)					State and private	National Park Service	Total
	042	T.S.	411	K-V	Total			
Idaho	1,147,795	91,719	93,016	55,351	1,387,881	86,523	--	1,474,404
Mont.	113,585	4,364	--	--	117,949		39,825	157,774
Wash.	84,995	9,974		6,595	101,564		--	101,564
Colo.							23,267	23,267
Wyo.							116,886	116,886
Total	1,346,375	106,057	93,016	61,946	1,607,394	86,523	179,978	1,873,895

042 - National Forest program including Regional Office expenditures.
T.S. - Technical services.
411 - Federal matching funds for State and private cooperative programs.
K-V - Stand improvement collections used for BRC on National Forest land.

1/ All funds expended in Region 1, including items for developmental work during fiscal year 1966, July 1, 1965 through June 30, 1966.

2. Net Acres of White Pine by Age Classes[1/]

Ownership	Age classes by date of origin						Total acres
	1980-1961	1960-1941	1940-1921	1920-1881	1880-1841	1840 & prior	
National Forest	12,800	28,570	208,210	408,740	54,560	323,420	1,036,300
National Park	- - - -	- - - -	Not classified		- - - -	- - - -	143,030
State & Private	3,400	44,470	93,470	129,610	20,720	153,830	444,770
Total	15,200	73,310	301,680	538,350	75,280	477,250	1,624,100

For a detailed breakdown of ownership, refer to the 1965 Blister Rust Contol Annual Report.

1/ This table includes all areas satisfactorily stocked with white pine as of December 31, 1966. The areas reported for the National Forest and the State and private programs have 20 percent or more white pine stocking. The area of white pine type based on plurality of stems or volume is much less than this. This table includes stands which are not white pine type by timber management definition but where blister rust control work has been considered necessary to maintain an adequately stocked stand. White pine sites presently unsatisfactorily stocked and protection zones are not included. The data reported for the National Forest program include only National Forest and Public Domain land. The data reported for the State and private program include only State and private lands.

3. Accumulative Summary of Antibiotic Treatment

Ownership	Idaho		Montana		Washington		Total	
	Total acres	Treated to date	Total acres	Treated to date	Total acres	Treated to date	Acres	Treated to date[1]
National Forest	866,080	319,960	92,570	34,510	77,650	33,400	1,036,300	387,870
National Park[2]	--	--	13,900	11,350	--	--	13,900	11,350
State & Private	431,800	75,720	4,470	--	8,500	--	444,770	75,720
Total	1,297,880	395,680	110,940	45,860	86,150	33,400	1,494,970	474,940

1/ The acres reported as treated through December 31, 1966, include some that that have been retreated.

2/ Only Glacier National Park has an antibiotic treatment program.

4. Antibiotic Treatment by Date and Ownership - Acres[1/]

Owner	1962 and prior	1963	1964	1965	1966	Summary				Total
						Within association		Outside association		
						Hand	Aerial	Hand	Aerial	
National Forest	175,050	102,710	77,160	73,650	1,990	18,870	16,280	69,430	278,340	382,920
Public Domain	1,920	1,610	1,240	210	--	180	740	150	3,880	4,950
State lands	24,810	4,680	13,350	10,290	1,800	22,280	15,190	2,650	6,740	46,860
L. Cardiff, Inc.	270	--	--	--	--	160	110	--	--	270
Diamond Internat.	570	--	230	60	--	200	200	30	370	800
Joslyn Mfg. Co.	--	--	220	--	--	--	--	--	220	220
Mead & Howard	10	30	--	60	--	10	60	30	--	100
Milwaukee Land	730	210	560	580	--	20	230	840	770	1,860
Northern Pacific	290	30	--	270	--	--	--	--	320	320
P.F.I.	8,820	2,850	5,600	6,970	1,310	10,280	10,060	830	1,170	22,340
Other private	1,070	70	1,760	450	--	670	200	220	1,860	2,950
Total	213,540	112,190	100,120	92,540	5,100	52,670	43,070	74,180	293,670	463,590

1/ This table includes all antibiotic treatment work done through December 31, 1966, in Idaho and Montana except Glacier National Park. The accumulative acres by dates will not necessarily add up to the totals shown in the summary section because of retreatment. Some of these acres have been treated more than once; however, an acre is only reported in the summary the first time it is treated.

SUMMARY OF NATIONAL FOREST AND STATE AND PRIVATE PROGRAMS

1. Field Organization, Calendar Year 1966

Program	Camps	Employees				Contractors
		Ribes eradication	Antibiotic treatment	Surveys & other	Total	
National Forest	14	246	98	66	410	3
State and Private	3	64	75	--	139	
Total	17	310	173	66	549	3

2. Total Progress of Ribes Eradication, Calendar Year 1966 1/

Ownership	Acres	Man-days	Ribes	Per acre	
				Man-days	Ribes
National Forest	10,470	10,643	4,264,900	1.02	407
State and Private	3,700	1,548	99,500	.42	27
Total	14,170	12,191	4,364,400	.86	308

1/ All areas worked either initially or reworked are included. The area in table 3 and all work done with Sale Area Betterment (K-V) funds are included.

3. Chemical Eradication, Calendar Year 1966

Ownership	Acres 1/	Man-days	Ribes destroyed	Gallons of spray solution	Man-days per acre
National Forest	500	463	2,280,000	61,400	0.93
State and Private	--	--	--	--	--
Total	500	463	2,280,000	61,400	.93

1/ Acres sprayed with 2,4,5-T herbicide to eradicate ribes. Application was from truck-mounted or backpack sprayers and helicopters. These data are also incorporated in table 2.

4. Antibiotic Treatment--Basal Stem Method, Calendar Year 1966

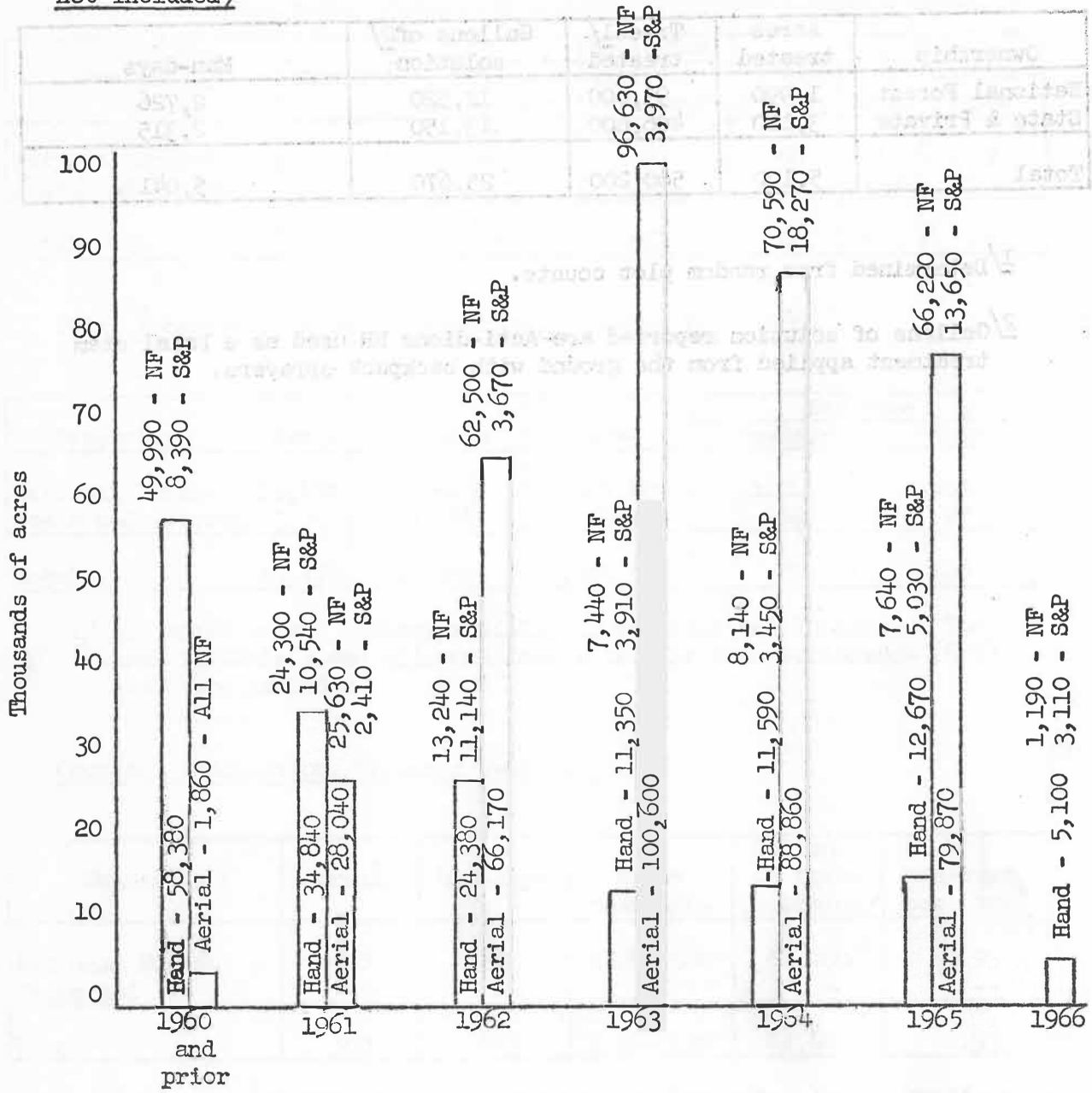
Ownership	Acres treated	Trees1/ treated	Gallons of2/ solution	Man-days
National Forest	1,990	93,600	12,520	2,726
State & Private	3,110	406,600	13,150	2,315
Total	5,100	500,200	25,670	5,041

1/ Determined from random plot counts.

2/ Gallons of solution reported are Acti-dione BR used as a basal stem treatment applied from the ground with backpack sprayers.

SUMMARY OF NATIONAL FOREST
AND STATE AND PRIVATE PROGRAMS

5. Region 1 summary of antibiotic treatment through 1966 (National Parks not included)



1. Blister Rust Control Expenditures, Fiscal Year 1966

Forest	Funds		
	Regular	K-V	Total
Clearwater	253,761	33,353	287,114
Coeur d'Alene	252,824	21,132	273,956
Colville	355	1,610	1,965
Kaniksu	362,997	5,851	368,848
Kootenai	93,502	--	93,502
St. Joe	235,439	--	235,439
Total	1,198,878	61,946	1,260,824

2. Field Organization, Calendar Year 1966

Forest	Camps	Employees				Contractor
		Ribes eradication	Antibiotic treatment	Surveys & other	Total	
Clearwater	4	106	--	10	116	1
Coeur d'Alene	4	63	29	16	108	
Kaniksu	3	24	37	20	81	2
Kootenai	1	7	6	3	16	
St. Joe	2	46	26	17	89	
All Forests	14	246	98	66	410	3

3. Total Progress of Ribes Eradication, Calendar Year 1966 1/

Forest	Acres	Man-days	Ribes	Per acre	
				Man-days	Ribes
Clearwater	3,950	4,938	1,096,300	1.25	277
Coeur d'Alene	2,610	2,770	407,000	1.06	156
Kaniksu	1,980	1,265	64,300	.64	32
Kootenai	190	129	3,100	.68	16
St. Joe	1,740	1,541	2,694,200	.89	1,548
All Forests	10,470	10,643	4,264,900	1.02	407

1/ All areas worked either initially or reworked are included. Both chemical eradication and all work done with Sale Area Betterment (K-V) funds are included.

4. Chemical Eradication, Calendar Year 1966

Forest	Acres 1/	Man-days	Ribes destroyed	Gallons of spray solution	Man-days per acre
Clearwater	190	298	283,000	22,400	1.57
Coeur d'Alene	70	140	49,000	16,800	2.00
Kaniksu	50	19	27,000	19,800	.38
Kootenai	--				
St. Joe	190	6	1,921,000	2,400	.03
All Forests	500	463	2,280,000	61,400	.93

1/Acres sprayed with 2,4,5-T herbicide to eradicate ribes. The application was from truck-mounted or backpack sprayers and helicopters. These data are included in table 3.

5. Antibiotic Treatment--Basal Stem Method, Calendar Year 1966

Forest	Acres treated	Trees treated 1/	Gallons of solution 2/	Man-days
Clearwater	--	--	--	--
Coeur d'Alene	310	39,700	2,920	638
Kaniksu	660	38,900	6,500	1,057
Kootenai	170	800	500	140
St. Joe	850	14,200	2,600	891
All Forests	1,990	93,600	12,520	2,726

1/Determined from random plot counts.

2/Gallons of solution reported are Acti-dione BR used as a basal stem treatment applied from the ground with backpack sprayers.

6. K-V Work. Calendar Year 1966

Forest	Ribes eradication		Basal stem antibiotic treatment		Total	
	Acres	Man-days	Acres	Man-days	Acres	Man-days
Clearwater	430	919	--	--	430	919
Coeur d'Alene	790	870	--	--	790	870
Kaniksu	565	688	--	--	565	688
Kootenai	--	--	--	--	--	--
St. Joe	--	--	--	--	--	--
All Forests	1,785	2,477			1,785	2,477

7. Accumulative Summary of Antibiotic Treatment[1/]

Forest	Idaho		Montana		Washington		Total	
	Total acres	Treated to date	Total acres	Treated to date	Total acres	Treated to date	Acres	Treated to date
Clearwater	275,520	58,860	--	--	--	--	275,520	58,860
Coeur d'Alene	277,060	95,600	24,700	3,220	--	--	301,760	98,820
Colville	--	--	--	--	25,640	10,870	25,640	10,870
Kaniksu	169,140	66,500	31,920	9,510	52,010	22,530	253,070	98,540
Kootenai	2,640	630	35,950	21,780	--	--	38,590	22,410
St. Joe	141,720	98,370	--	--	--	--	141,720	98,370
All Forests	866,080	319,960	92,570	34,510	77,650	33,400	1,036,300	[2/]387,870

[1/] Acres reported as treated through December 31, 1966, include some that have been retreated.

[2/] Includes 4,950 acres of Public Domain.

STATE AND PRIVATE LANDS

1. Blister Rust Control Expenditures, Fiscal Year 1966

Forest	Funds				Total all funds
	State	Private	Total S&P	Federal	
Clearwater	32,866	10,702	43,568	44,653	88,221
Kaniksu	4,588	--	4,588	5,553	10,141
St. Joe	30,237	8,756	38,993	40,837	79,830
Total	67,691	19,458	87,149	91,043	178,192

2. Field Organization, Calendar Year 1966

Forest	Camps	Employees			Contractors
		Ribes eradication	Antibiotic treatment	Total	
Clearwater	2	25	75	100	--
Kaniksu	--	--	--	--	--
St. Joe	1	39	--	39	--
Total	3	64	75	139	--

3. Total Progress of Ribes Eradication, Calendar Year 1966

Area	Forest	Acres	Man-days	Ribes	Per acre	
					Man-days	Ribes
Within 1/ association	Clearwater	--	--	--	--	--
	Kaniksu	--	--	--	--	--
	St. Joe	3,700	1,548	99,500	0.42	27
	Total	3,700	1,548	99,500	.42	27

1/No ribes eradication work performed outside of association boundaries. Areas worked initially or reworked are both included.

4. Antibiotic Treatment--Basal Stem Method, Calendar Year 1966

Area	Forest	Acres treated 1/	Trees treated	Gallons of solution 2/	Man-days
Within association	Clearwater	2,770	397,600	11,140	2,054
	Kaniksu	--	--	--	--
	St. Joe	--	--	--	--
	Total	2,770	397,600	11,140	2,054
Outside association	Clearwater	--	--	--	--
	Kaniksu	310	8,500	1,950	231
	St. Joe	30	500	60	30
	Total	340	9,000	2,010	261
All Forests		3,110	406,600	13,150	2,315

1/Determined from random plot counts.

2/Gallons of solution reported are Acti-dione BR used as a basal stem treatment applied from the ground with backpack sprayers.

5. Accumulative Summary of Antibiotic Treatment 1/

Forest	Ownership	Idaho		Montana		Washington		Total	
		Total acres	Treated to date	Total acres	Treated to date	Total acres	Treated to date	Acres	Treated to date
Clearwater	State	49,890	9,690	--	--	--	--	49,890	9,690
	Private	114,160	17,610	--	--	--	--	114,160	17,610
	Total	164,050	27,300	--	--	--	--	164,050	27,300
Coeur d'Alene	State	14,630	1,220	--	--	--	--	14,630	1,220
	Private	46,840	--	1,970	--	--	--	48,810	--
	Total	61,470	1,220	1,970	--	--	--	63,440	1,220
Colville	State	--	--	--	--	2,550	--	2,550	--
	Private	--	--	--	--	--	--	--	--
	Total	--	--	--	--	2,550	--	2,550	--
Kaniksu	State	35,240	13,010	680	--	710	--	36,630	13,010
	Private	10,840	1,060	1,820	--	5,240	--	17,900	1,060
	Total	46,080	14,070	2,500	--	5,950	--	54,530	14,070
St. Joe	State	53,400	22,940	--	--	--	--	53,400	22,940
	Private	106,800	10,190	--	--	--	--	106,800	10,190
	Total	160,200	33,130	--	--	--	--	160,200	33,130
All Forests	State	153,160	46,860	680	--	3,260	--	157,100	46,860
	Private	278,640	28,860	3,790	--	5,240	--	287,670	28,860
	Total	431,800	75,720	4,470	--	8,500	--	444,770	75,720

1/ Acres reported as treated through December 31, 1966 include some that have been retreated.

NATIONAL PARKS PROGRAM

1. Expenditures, Fiscal Year 1966

Park	State	National Park Funds		
		Park	Regional	Total
Glacier	Montana	34,464	5,361	39,825
Yellowstone	Wyoming	110,333	6,404	116,737
Grand Teton	Wyoming	--	149	149
Rocky Mountain	Colorado	20,289	2,978	23,267
Total		165,086	14,892	179,978

2. Field Organization, Fiscal Year 1966

Park	Camps	Employees		
		Ribes eradication	Antibiotic treatment	Total
Glacier	1		23	23
Rocky Mountain	1	16		16
Yellowstone	3	70	--	70
Total	5	86	23	109

3. Total Progress Ribes Eradication, Fiscal Year 1966

Park	Acres	Man-days	Ribes	Per acre	
				Man-days	Ribes
Rocky Mountain	420	770	515,000	1.83	1,226
Yellowstone	13,280	3,460	470,000	.26	35
Total	13,700	4,230	985,000	.31	72

4. Chemical Eradication, Fiscal Year 1966

Park	Acres	Man-days	Ribes	Gallons of solution
Rocky Mountain	50	440	473,200	17,250
Yellowstone	310	815	297,500	24,500
Total	360	1,255	770,700	41,750

5. Antibiotic Treatment--Basal Stem Method, Fiscal Year 1966

Park	Acres treated	treated	Gallons of solution	Man-days	Man-days per acre
Glacier	1/1,200	148,680	3,020	781	0.65
Total	1,200	148,680	3,020	781	.65

1/ Includes 920 acres of retreatment.

6. Accumulative Summary of Antibiotic Treatment--Acres 1/

Park	Within units		Outside units		All units	
	Total	Treated to date	Total	Treated to date	Total	Treated to date
Glacier 2/	6,010	3,580	7,890	7,770	13,900	11,350
Grand Teton	1,010	--	--	--	1,010	--
Rocky Mountain	12,650	--	--	--	12,650	--
Yellowstone	115,470	--	--	--	115,470	--
Total	135,140	3,580	7,890	7,770	143,030	11,350

1/ The acres reported as treated through December 31, 1966, include some that have been retreated.

2/ At present time, only Glacier National Park has an antibiotic treatment program. Control in other Parks is based on ribes eradication only.